CELV-86-0333

Environmental Impact Analysis Process

ENVIRONMENTAL ASSESSMENT
COMPLEMENTARY EXPENDABLE LAUNCH VEHICLE

CAPE CANAVERAL AIR FORCE STATION
FLORIDA

JUNE 1986

DEPARTMENT OF THE AIR FORCE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE STATION, PO BOX 92960
LOS ANGELES, CA 90009-2960

18 AUG 1986

To: Governmental Agencies, Public Officials, Public Groups and Interested Individuals

Attached for thirty (30) day public notification, in compliance with the National Environmental Policy Act and the regulations of the President's Council on Environmental Quality, is the Finding of No Significant Impact and the Environmental Assessment for the Complementary Expendable Launch Vehicle (CELV) at Cape Canaveral Air Force Station, Florida.

The Finding of No Significant Impact and the Environmental Assessment addresses the modification to Launch Complex 41 at Cape Canaveral Air Force Station necessary to launch the CELV, pre and post CELV launch processing and operations at Complex 41, and launching of the CELV from Launch Complex 41.

The thirty (30) day public notification period begins on 25 August 1986 and ends on 24 September 1986. Copies of the Finding of No Significant Impact and the Environmental Assessment may be obtained by writing to:

Department of the Air Force
Headquarters Space Division/DEV
Attn: Mr. Robert Mason
P.O. Box 92960
Los Angeles, CA 90009-2960

or by calling: Mr. Robert Mason at (213) 643-0933

Sincerely

Raymond E. Rodgers

RAYMOND E. RODGERS, JR., Colonel, USAF
Director of Acquisition Civil Engineering

ENVIRONMENTAL ASSESSMENT

FOR THE COMPLEMENTARY EXPENDABLE LAUNCH VEHICLE (CELV) AT

CAPE CANAVERAL AIR FORCE STATION, FLORIDA

June 1986

Prepared For: Department of Air Force
Headquarters Space Division
Environmental Planning Division
Directorate of Acquisition Civil Engineering

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FINDING OF NO SIGNIFICANT IMPACT (FONSI)
COMLEMENTARY EXPENDABLE LAUNCH VEHICLE PROGRAM
CAPE CANAVERAL AIR FORCE STATION, FLORIDA

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

To support the Department of Defense (DOD) Space Program, and to ensure access to space through a secondary launch capability using expendable launch vehicles, the U.S. Air Force (USAF) proposes to renovate and modify Launch Complex 41 at Cape Canaveral Air Force Station (CCAFS), Florida, to accommodate the proposed Complementary Expendable Launch Vehicle (CELV) program.

PROPOSED ACTION

The proposed action calls for the renovation and modification of an existing launch complex (Launch Complex 41) located on the northernmost extension of CCAFS. This action is required to support the USAF's CELV program utilizing modified Titan 34D space boosters known as Titan 34D7. The CELV program is designed to provide additional space launch capability for USAF launches in support of DOD programs. The payload capacities of the Titan 34D7 are compatible with those of the Space Shuttle.

Launch Complex 41, which was used to launch Titan space boosters until 1977, retains skeleton structures of the umbilical and mobile service towers, in-place fuel storage areas, and a launch pad. The renovations and modifications to the complex include tearout and refurbishment of structural, mechanical, and electrical systems; and modification of transport and fuel systems, including the installation of air pollution control devices for the fuel and oxidizer systems.

Following renovation and modification of Launch Complex 41 facilities, systems and space vehicles will be tested to validate their performance against design requirements. Initial Launch Capability (ILC) for the proposed CELV is October 1988.

SUMMARY OF ENVIRONMENTAL IMPACTS

NATURAL ENVIRONMENT

Air Quality

The proposed CELV program will not significantly impact air quality of CCAFS or surrounding areas. Primary constituents of the ground level exhaust cloud produced by the solid rocket motors (SRMs) of the Titan 34D7 will be carbon monoxide (CO), hydrogen chloride (HCl), and aluminum oxide (Al_2O_3). Because the nearest uncontrolled area is 16 kilometers (km) from the launch site, it is expected that the general population will not be exposed to HCl concentrations greater than the current Occupational Safety and Health Administration (OSHA) permissible limit of 5 parts per million (ppm). In addition, concentrations of CO and Al_2O_3 are predicted not to exceed the National Ambient Air Quality Standards (NAAQS), anywhere beyond the immediate area adjacent to the launch complex. As part of the renovation of Launch Complex 41, air pollution control devices will be installed to control the emissions of Aerozine 50 and nitrogen tetroxide (N_2O_4). In addition, spill control and containment facilities are sufficient to retain emergency or accidental spills and prevent release of hazardous fumes to the atmosphere.

Soils

Implementation of the CELV program, including the refurbishment of Launch Complex 41, will not involve new excavation and will not impact soils on CCAFS.

Hydrology

No significant impacts to ground water or surface water hydrology will result from the CELV program. All water use for the CELV program will come from municipal water supplies and will be stored prior to use in a 1,000,000-gallon tank located on CCAFS. Some ground water recharge will occur as the result of deluge water and fire suppressant and launch complex washdown water flowing directly off the pad and discharging to grade. All water discharged to grade will percolate into the surficial water table and flow toward the Banana River.

Water Quality

No significant long-term adverse impacts to water quality will occur as a result of the CELV program. All deluge water and fire suppressant water collected in the flame bucket will be analyzed prior to discharge to grade. If this water is contaminated, it will be removed and disposed of offsite in an appropriate manner. Spill control and containment facilities are provided for all fuel tank areas to prevent the accidental release of propellants to the environment. The potential exists for a short-term, localized impact on water quality in the unlikely event of an early inflight failure of the Titan 34D7 vehicle. Due to the hypergolic nature of the liquid fuels, and the activation of the vehicle destruct system following a near-pad flight failure, minimal contamination of surface waters is expected following such an event.

Surface water quality will not be significantly impacted by deposition of HCl or Al_2O_3 from the ground cloud produced during liftoff of the Titan 34D7 vehicle. Any HCl deposited in surrounding surface waters will be rapidly neutralized by the extensive buffering capacity of the Banana River and adjacent marshes. In addition, any Al_2O_3 deposited in surface waters will remain insoluble and will not be toxic to aquatic life.

Biota

No significant impacts to the biota of CCAFS and surrounding areas are expected to result from the CELV program. No additional habitat will be lost or permanently disturbed due to the proposed activities. No critical habitat for threatened or endangered species will be lost due to the CELV program. Aquatic organisms will not be significantly impacted due to deposition of HCl or Al_2O_3 from the ground level exhaust cloud.

MAN-MADE ENVIRONMENT

Population

The renovation and modification of Launch Complex 41 and the subsequent launch program of the CELV will have no significant impacts on population and housing on CCAFS or surrounding communities. The CELV program will utilize existing personnel available at CCAFS, Patrick Air Force Base (PAFB), or surrounding communities.

Socioeconomics

Launch Complex 41 was established in the mid-1960s. The proposed CELV program is compatible with the surrounding land use, will not require additional acreage outside the boundaries of the complex, and will not require new utility services, new transportation access, or additional employment. No significant impacts to the socioeconomics of CCAFS or Brevard County, Florida, are anticipated.

Safety

Safety aspects of prelaunch, launch, and postlaunch phases of the proposed CELV program have been addressed in the T34D7 Accident Risk Assessment Report (ARAR) (see Appendix A). This report addresses the Titan 34D7 flight vehicle, support equipment, and Launch Complex 41 facilities. All procedures during prelaunch, launch, and postlaunch phases of the CELV program will be carried out according to the ARAR to ensure optimal safety for all onbase personnel.

Noise

Noise pollution associated with the CELV program will not significantly affect the general public due to the distance between the launch site and the nearest unregulated area (i.e., 16 km). Noise produced during the launch will be of short duration and at worst will be an infrequent nuisance rather than a health hazard.

Archaeology and Cultural Resources

Launch Complex 41 or the surrounding area does not contain any unique archaeological or historical resources. No new construction is required offsite. As a result, the CELV program will have no adverse impacts to archaeological or cultural resources.

FINDINGS

Based upon the above, a finding of no significant impact is made. An Environmental Assessment of the proposed action, dated June 1986, is on file at:

HQ Space Division
P.O. Box 92960
Worldway Postal Center
Los Angeles, CA 90009
ATTENTION: Mr. Robert C. Mason, SD/DEV

TABLE OF CONTENTS

Section		Page
1.0	PROPOSED ACTION AND ALTERNATIVES	1-1
	1.1 PROPOSED ACTION	1-1
	1.2 ALTERNATIVE ACTIONS	1-7
	1.3 NO-ACTION ALTERNATIVE	1-7
2.0	ENVIRONMENTAL DESCRIPTION AND IMPACTS	2-1
	2.1 NATURAL ENVIRONMENT	2-1
	2.1.1 Meteorology	2-1
	2.1.1.1 General Description	2-1
	2.1.1.2 Site Specific	2-3
	2.1.2 Air Quality	2-3
	2.1.2.1 Description of Emissions	2-10
	2.1.3 Geology	2-24
	2.1.4 Soils	2-25
	2.1.5 Hydrology	2-25
	2.1.5.1 Ground Water	2-25
	2.1.5.2 Surface Water	2-34
	2.1.6 Water Quality	2-35
	2.1.6.1 Ground Water	2-35
	2.1.6.2 Surface Water	2-44
	2.1.7 Biota	2-55
	2.1.7.1 Terrestrial Biota	2-56
	2.1.7.2 Aquatic Biota	2-59
	2.1.7.3 Endangered and Threatened Species	2-63
	2.2 MANMADE ENVIRONMENT	2-67
	2.2.1 Population	2-67
	2.2.1.1 Demography	2-67
	2.2.1.2 Housing	2-67

TABLE OF CONTENTS
(Continued, Page 2 of 3)

Section		Page
	2.2.2 Socioeconomics	2-68
	2.2.2.1 Land Use Compatibility	2-68
	2.2.2.2 Community Facilities and Services	2-70
	2.2.2.3 Economy	2-75
	2.2.3 Safety	2-76
	2.2.4 Noise Pollution	2-76
	2.2.4.1 Noise	2-76
	2.2.4.2 Sonic Boom	2-80
	2.2.5 Archaeological and Cultural Resources	2-84
3.0	REGULATORY REVIEW	3-1
	3.1 AIR QUALITY	3-1
	3.2 WATER QUALITY	3-2
	3.2.1 Industrial Wastewater Discharge	3-2
	3.2.2 Stormwater Drainage	3-4
	3.2.3 Surface Water Management	3-4
	3.2.4 Sanitary Wastewater Discharge	3-4
	3.3 HAZARDOUS WASTES	3-5
	3.4 SPILL PREVENTION	3-5
	3.5 COASTAL MANAGEMENT PROGRAM	3-5
	3.6 ENDANGERED SPECIES	3-7
4.0	MITIGATION	4-1
	4.1 AIR QUALITY	4-1
	4.2 SOILS	4-3
	4.3 WATER QUALITY	4-3
	4.3.1 Ground Water	4-3
	4.3.2 Surface Water	4-4
	4.4 BIOTA	4-4
	4.5 POPULATION	4-5

TABLE OF CONTENTS
(Continued, Page 3 of 3)

Section		Page
	4.5.1 Demography and Housing	4-5
	4.6 SOCIOECONOMICS	4-5
	4.6.1 Land Use Compatibility	4-5
	4.6.2 Community Facilities and Services	4-5
	4.6.3 Transportation	4-5
	4.6.4 Economy	4-5
	4.7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES	4-5
	4.8 AESTHETICS	4-6
	4.9 HAZARDOUS WASTES	4-6
	4.10 NOISE	4-6
5.0	LIST OF AGENCIES AND INDIVIDUALS CONTACTED	5-1
APPENDICES		
	APPENDIX A--T34D7 ACCIDENT RISK ASSESSMENT REPORT	A-1
	APPENDIX B--USFWS CONSULTATION	B-1
	APPENDIX C--SPECIES LISTS	C-1

LIST OF TABLES

Table		Page
1.1-1	Propellant Quantity Comparison for Titan IIIC, Titan 34D, and Titan 34D7	1-5
2.1-1	General Climatology of Cape Canaveral	2-4
2.1-2	Products of Combustion at Nozzle Exit Plane Solid Rocket Motors	2-11
2.1-3	Products of Combustion at Nozzle Exit Plane Liquid Fuel Engines (N_2O_4/A-50)	2-12
2.1-4	Stratigraphic Units Underlying CCAFS	2-26
2.1-5	Soils Engineering Characteristics	2-29
2.1-6	Water Quality Characteristics of Floridan Aquifer at CCAFS	2-36
2.1-7	Annual Mean Ground Water Data, Unconfined Aquifer CCAFS, 1985	2-38
2.1-8	Results of EP Toxicity Test for Paint Chips from Launch Complex 41	2-42
2.1-9	Mean Surface Water Quality Associated with Launch Complexes 40 and 41 from Quarterly Monitoring Program 1983 Through 1985	2-45
2.1-10	Mean Surface Water Quality in Banana River Adjacent to CCAFS	2-47
2.1-11	Endangered and Threatened Species Residing or Seasonally Ocurring on CCAFS and Adjoining Waters	2-65
2.2-1	Estimated Maximum Ground-Level Sound Levels and Duration of Titan III C and D	2-78
2.2-2	Permissible Noise Exposure (Occupational Personnel)	2-81
3.3-1	Expected Hazardous Wastes Produced from CELV Operations	3-6

LIST OF FIGURES

Figure		Page
1.1-1	Location Map	1-2
1.1-2	Base Map	1-3
2.1-1	Wind Rose--Cape Canaveral, 1968-1978 Annual	2-5
2.1-2	Wind Rose--Cape Canaveral, April 1968-1977	2-6
2.1-3	Wind Rose--Cape Canaveral, July 1968-1977	2-7
2.1-4	Wind Rose--Cape Canaveral, October 1968-1977	2-8
2.1-5	Wind Rose--Cape Canaveral, January 1969-1978	2-9
2.1-6	Launch Complex-41 Fuel Vent System with FVIS	2-14
2.1-7	Launch Complex-41 Oxidizer Vent System with OVSS	2-16
2.1-8	Estimated Peak Ground Level HCl Concentration Downwind from Launch Site	2-19
2.1-9	Estimated Peak Ground Level CO Concentration Downwind from Launch Site	2-21
2.1-10	Estimated Peak Ground Level Al_2O_3 Concentrations Downwind from Launch Site	2-22
2.1-11	Geologic Cross Section	2-27
2.1-12	Patterns of Underlying Soil Types	2-28
2.1-13	Generalized Ground Water Flow Direction in the Unconfined Aquifer	2-32
2.1-14	Surface and Ground Water Quality Monitoring Locations	2-37
2.2-1	Existing Land Use	2-69
2.2-2	Transportation Network CCAFS	2-73
2.2-3	Estimated Maximum Overall Sound Pressure Levels at Ground Positions During Launch of Titan III Vehicles	2-79

LIST OF FIGURES
(Continued, Page 2 of 2)

Figure		Page
2.2-4	Sound Pressure Level Spectra for a Titan IIID at Four Distances	2-82
2.2-5	Location of Sites Recommended for Further Evaluation	2-93
4.1-1	FVIS--Current Configuration for Titan II Project	4-2

LIST OF ACRONYMS AND ABBREVIATIONS

ABI	Applied Biology, Inc.
AEROZINE 50	Hydrazine and UDMH Blend
AFCRL	Air Force Cambridge Research Laboratory
AFRPL	Air Force Rocket Propulsion Laboratory
AGE	Aerospace Ground Equipment
$AlCl_3$	aluminum chloride
Al_2O_3	aluminum oxide
ARAR	Accident Risk Assessment Report
ASTG	Aerospace Test Group
BACT	Best Available Control Technology
C^-	carbon anion
CCAFS	Cape Canaveral Air Force Station
CELV	Complementary Expendable Launch Vehicle
CFR	Code of Federal Regulations
CH^-	ionized hydrocarbon
CO	carbon monoxide
CO_2	carbon dioxide
CMP	Coastal Management Program
CZMA	Coastal Zone Management Act
dB	decibel
DOD	Department of Defense
CO_2	carbon dioxide
EIS	Environmental Impact Statement
EP	extraction procedure
EPA	U.S. Environmental Protection Agency

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 2 of 5)

ES	Environmental Shelter
ETR	Eastern Test Range
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulation
FGFWFC	Florida Game and Fresh Water Fish Commission
FPL	Florida Power and Light Company
ft	feet
FVIS	fuel vapor incinerator system
gpd	gallons per day
H^+	hydrogen cation
HCl	hydrogen chloride
H_2	hydrogen molecule
H_2O	water
Hz	hertz
ICBM	Intercontinental Ballistic Missile
ILC	Initial Launch Capability
ITL	Integrate Transfer and Launch
IUS	inertial upper stage
km	kilometer
KSC	Kennedy Space Center
kV	kilovolt
kw	kilowatts
lbs	pounds
LH_2O_2	liquid hydrogen and liquid oxygen

m	meter
MCL	maximum contaminant levels
MISB	Motor Inert Storage Building
mg/L	milligram per liter
MGD	million gallons per day
mg/m^3	milligrams per cubic meter
msl	mean sea level
MSPSP	Missile System Prelaunch Safety Package
MST	mobile service tower
N	newtons
N_2	nitrogen molecule
N_2O_4	nitrogen tetroxide
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide
NASA	National Aeronautics and Space Administration
NIOSH	National Institute of Occupational Safety
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
$O^=$	oxygen ion
O_2	oxygen molecule
OH^-	hydroxide ion
OPB	Office of Planning and Budgeting
OSHA	Occupational Safety and Health Administration
OVSS	oxidizer vapor scrubber system

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 4 of 5)

PAFB	Patrick Air Force Base
PEL	permissible exposure limit
pH	$-\log[H^+]$
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation Recovery Act
RSV	ready storage vessel
SCS	Soil Conservation Service
SMAB	Solid Motor Assembly Building
SPCC	Spill Prevention Control and Countermeasure
SPL	sound pressure level
SR	State Road
SRB	Solid Rocket Booster
SRMs	Solid Rocket Motors
STP	sewage treatment plant
STS	Space Transportation System
UDMH	unsymmetrical dimethyl hydrazine
$ug\text{-}Al/m^2$	micrograms of aluminum per square meter
ug/m^3	micrograms per cubic meter
UT	umbilical tower
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
VAFB	Vandenberg Air Force Base

VIB	Vertical Integration Building
WIND	Weather Information Network Display

1.0 PROPOSED ACTION AND ALTERNATIVES

In support of the Department of Defense (DOD) space program, the U.S. Air Force (USAF) proposes to renovate and modify Launch Complex 41 at Cape Canaveral Air Force Station (CCAFS), Florida, to accommodate the proposed Complementary Expendable Launch Vehicle (CELV) program. This Environmental Assessment addresses the environmental effects of the CELV program.

CCAFS is located on the east coast of Florida, in Brevard County near the City of Cocoa Beach, and approximately 15 miles north of Patrick Air Force Base (PAFB). The station is adjacent to the National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC), Merritt Island, Florida. CCAFS occupies approximately 15,800 acres (a 25-square-mile area) of the barrier island that contains Cape Canaveral. The station is bounded by the Atlantic Ocean to the east and the Banana River to the west (see Figure 1.1-1). A base map of CCAFS, showing the locations of launch complexes and support facilities, is presented in Figure 1.1-2.

Launch Complex 41 is located within the Integrate Transfer and Launch (ITL) Complex of CCAFS and is located on the northernmost portion of the station. Wetlands associated with the upper reaches of the Banana River are located approximately 1,000 feet (ft) to the west of Launch Complex 41, while the Atlantic Ocean is located approximately 1,300 ft to the east of the launch complex. The vegetation surrounding Launch Complex 41 consists of dense thickets of coastal scrub and, to the northwest, a stand of dense Australian pine.

1.1 PROPOSED ACTION

USAF, Headquarters Space Division, Los Angeles, California, proposes to renovate and modify Launch Complex 41 at CCAFS. This activity is required to support the Air Force's CELV program utilizing modified

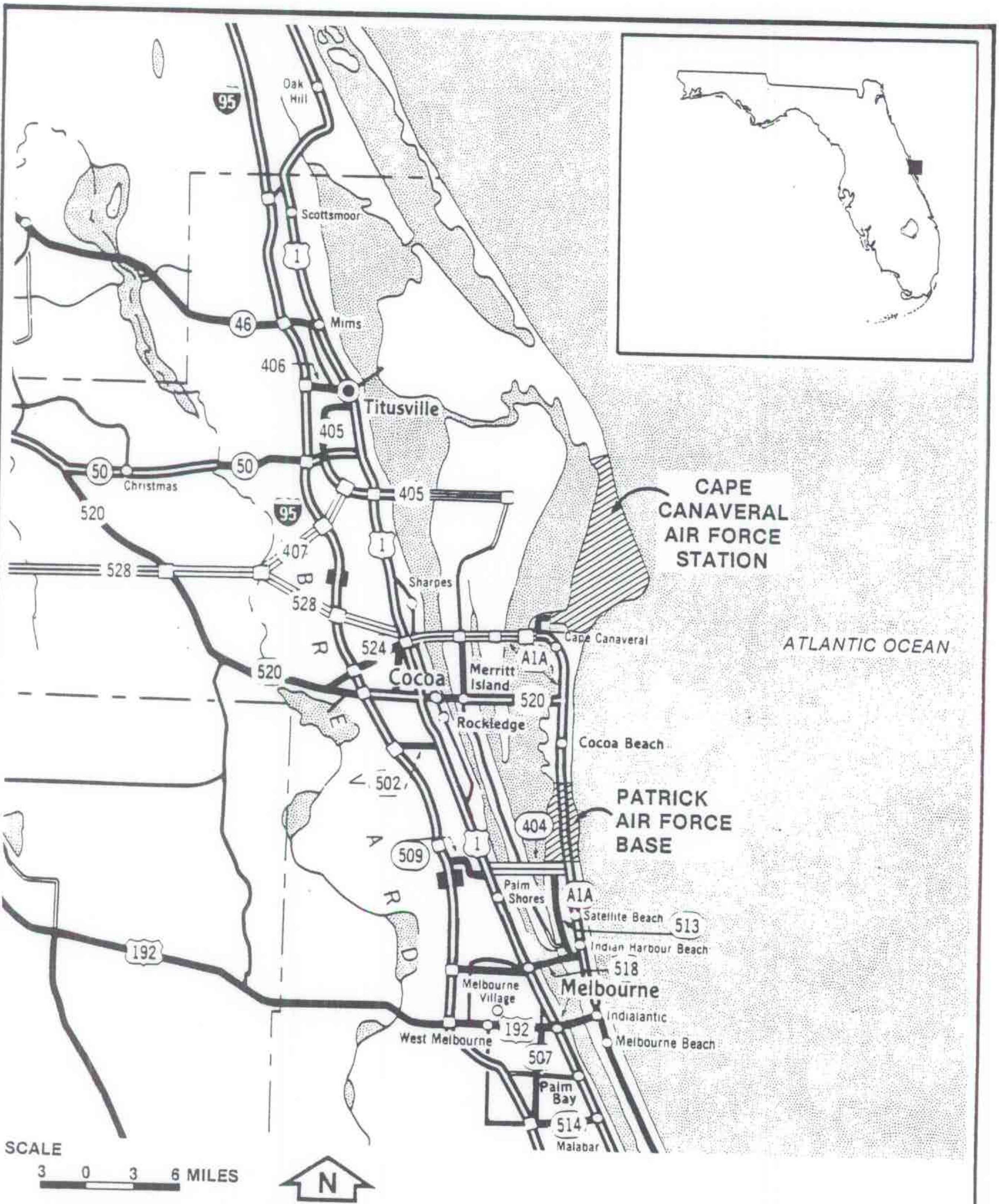

Figure 1.1-1
LOCATION MAP

SOURCE: ESE, 1986.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

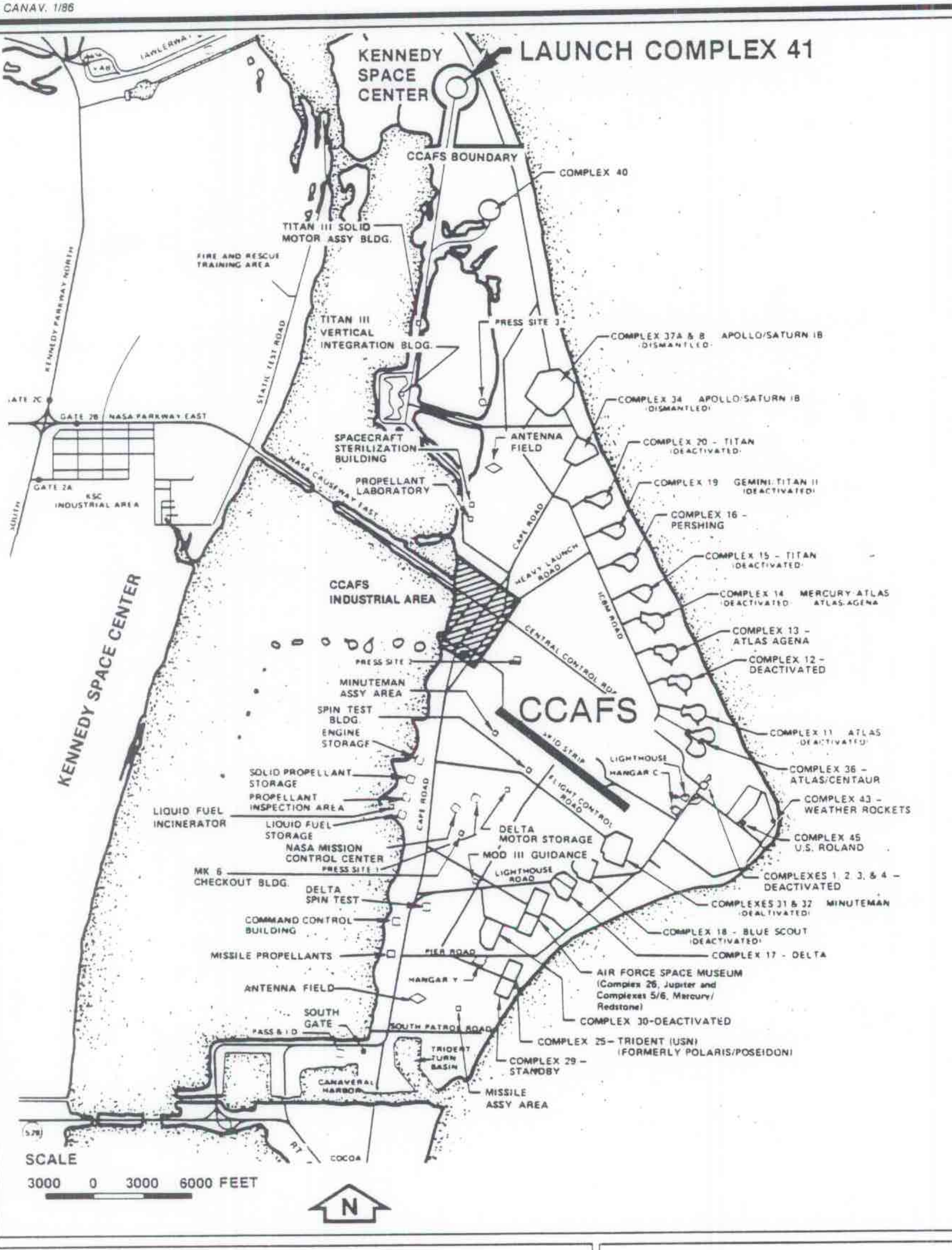

Figure 1.1-2
BASE MAP

SOURCE: ESE, 1986.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

Titan 34D space boosters known as Titan 34D7. The proposed CELV program at CCAFS will have an Initial Launch Capability (ILC) of 1 October 1988.

The CELV launch vehicle is not a new design development for this mission. The Titan 34D7 consists of growth versions of the existing Titan 34D and Centaur upper-stage vehicles, which are currently operational at CCAFS under existing USAF and NASA programs. Configuration changes involved are as follows:

1. Solid Rocket Motors (SRMs) on Titan 34D are 5 1/2 segments of solid propellant which will be extended to 7 segments for the CELV missions.
2. The core vehicle is a standard Titan 34D core with the length of Stage I and II stretched approximately 111 inches to provide for additional liquid propellant.
3. The upper stage consists of a Centaur or inertial upper stage (IUS). Depending on the mission, either Centaur upper stage or IUS will be employed.
4. The payload fairing is being designed to accommodate payload bay capacity of the Space Shuttle Orbiter (15 ft x 60 ft).

A comparison of Titan IIIC, Titan 34D, and Titan 34D7 propellants and quantities is shown in Table 1.1-1.

The decision to use the existing Launch Complex 41 as a launch facility for CELV was based on (1) an analysis that the skeleton structures of the umbilical tower (UT) and mobile service tower (MST) are structurally sound and (2) Launch Complex 41's previous successful utilization for launching Titan space boosters. Launch Complex 41 was originally constructed in 1963-1964 and was used by the USAF from 1964 to 1977 for launching of Titan space boosters. No launch activities have occurred at this complex since 1977.

The proposed action contains two major tasks, including the renovation and modification of the Launch Complex 41 launch and support facilities

Table 1.1-1. Propellant Quantity Comparison for Titan IIIC, Titan 34D, and Titan 34D7

Vehicle	Type of Propellant	Quantity of Propellants (lb)
Titan IIIC		
Stage Zero	Solid Rocket Fuel	890,000
Stage One	N_2O_4/Aerozine 50	259,000
Stage Two	N_2O_4/Aerozine 50	67,000
Stage Three (transtage)	N_2O_4/Aerozine 50	23,400
Titan 34D		
Stage Zero	Solid Rocket Fuel	929,400
Stage One	N_2O_4/Aerozine 50	295,000
Stage Two	N_2O_4/Aerozine 50	68,000
Titan 34D7		
Stage Zero	Solid Rocket Fuel	1,183,384
Stage One	N_2O_4/Aerozine 50	341,000
Stage Two	N_2O_4/Aerozine 50	77,000
*IUS or	Solid Rocket Fuel	27,400
*Centaur Upper Stage	LH_2/LO_2	45,500

lb = pounds.
LH_2/LO_2 = Liquid hydrogen and liquid oxygen.
Aerozine 50 = Equal parts of hydrazine and unsymmetrical dimethyl hydrazine.

*Either an IUS or Centaur upper stage will be used with the Titan 34D7 vehicle, depending on mission requirements.

Sources: USAF, 1975; Martin Marietta, 1985a.

and the subsequent testing and launching of Titan 34D7 space boosters. The proposed action contains the following activities required to meet ILC for Titan 34D7 CELV:

- o Tearout and Refurbishment--Prior to modification of Launch Complex 41 for the CELV program, obsolete or damaged systems will be removed, systems that do not require change will be refurbished, and design criteria for facility and Aerospace Ground Equipment (AGE) will be developed and incorporated. Refurbishment will involve two discrete phases, including sandblasting and refurbishing the structural joints, and installing new deck plates, stairwells, handrails, etc.

- o Facility Design--Launch Complex 41 modifications include structural, mechanical, and electrical modifications to the MST, UT, and AGE. Upper stage facility and AGE modifications will include strengthening of the structures for higher wind loads, a new Environmental Shelter (ES), and replacement of all remaining systems removed during tearout. The major AGE design modifications will include modifying the transport systems, providing one new fuel ready storage vessel (RSV) for the storage area previously used by the Titan 34D program, upgrading air conditioning systems, and modifying onsite fuel systems.

- o Systems and Vehicle Testing--The performance testing of each vehicle will be coordinated with Range Safety and the 6555 Aerospace Test Group (ASTG) to ensure all hazardous operations are properly controlled prior to performance of the test.

  The core vehicle will be assembled and tested in the Vertical Integration Building (VIB). The SRMs will be assembled and tested in the Solid Motor Assembly Building (SMAB). The payload fairing will be processed in the Motor Inert Storage Building (MISB) and installed in the ES prior to arrival of payload. The upper stage will be assembled and tested in the SMAB. The Launch Transporter will be used to move the core vehicle to the SMAB, attach five segments of each SRM, and to move the core vehicle to Launch Complex 41. After arrival, the top two segments for each SRM will be installed. Next, the upper stage will move to Launch Complex 41 for mating to vehicle. All subsystems will be tied together to provide total systems validation. When this testing is complete, the payload will be installed, and payload fairing will be moved in place.

- Launches--A breakdown of individual launch activities is available in the Titan 34D7 Accident Risk Assessment Report (ARAR) (13).

1.2 ALTERNATIVE ACTIONS

Alternative actions to the Titan 34D7 CELV project included two proposed alternatives. One alternative would have included launching a different expendable launch vehicle from Launch Complex 41 (CCAFS), which would have included different modifications to the launch complex. The second alternative would have included launching an expandable launch vehicle from Launch Complex 39A or 39B (KSC), which would have required modifications to these complexes. Details of these alternatives are considered proprietary information and cannot be released. However, these alternatives would have relied on either the modification to existing space launch vehicles, or development of new space launch vehicles that would have the same basic type of environmental impacts as the CELV Titan 34D7. The selection criteria was based on economics, ability to meet technical requirements, and ability of the launch vehicle to place DOD satellites in orbit on schedule.

1.3 NO-ACTION ALTERNATIVE

If the CELV program is not implemented as planned, the no-action alternative will require that the 10 payloads scheduled to fly on CELV would be launched from the Space Shuttle. This would mean 10 additional shuttle launches in the 5-year period beginning in 1988. The environmental impacts of launching the Space Shuttle from KSC are documented in the Final Environmental Impact Statement for the Space Shuttle (17). Launch Complex 41 would then remain as abandoned in place.

DOD has determined that there is a need for assured access to space through a secondary launch capability using expendable launch vehicles. The CELV has been identified as the secondary space launch capability.

2.0 ENVIRONMENTAL DESCRIPTION AND IMPACTS

2.1 NATURAL ENVIRONMENT

2.1.1 Meteorology

2.1.1.1 General Description--

The climate in Brevard County is characterized by long, relatively humid summers and mild winters. Rainfall is heaviest in summer--approximately 65 percent of the annual total falls from June through October in an average year. The remaining 35 percent is evenly distributed throughout the rest of the year.

Temperatures in both summer and winter are moderated by the waters of the Indian and Banana Rivers and the Atlantic Ocean. Maximum temperatures in summers show little day-to-day variation, and temperatures as high as 95 degrees Fahrenheit (°F) are not uncommon. Minimum temperatures in winter vary considerably from day to day, largely because periodic invasions of cold, dry air move southward from across the continent.

In many areas, particularly near the water, temperatures seldom drop below freezing. In an average winter, temperatures drop to 28°F or lower approximately three times in the colder areas. The average date of the first freeze is December 30, and the last is January 27.

Most rainfall in summer occurs as afternoon and evening showers and thundershowers; occasionally 2 to 3 inches fall within 1 to 2 hours. Day-long rains in summer are rare and are generally associated with tropical storms. Rainfall in fall, winter, and spring is seldom as intense as in summer. Rainfall in excess of 8 inches during a 24-hour period can be expected to occur in 1 year in 25.

Hail falls occasionally during thunderstorms, but hailstones are usually small and seldom cause much damage. Snow is rare in Brevard County; when it occurs, it melts as it hits the ground.

Tropical storms can affect the area from early in June through mid-November. The possibility for winds to reach hurricane force (74 miles per hour or greater) in Brevard County in any given year is approximately 1 in 20.

Tornadoes may occur but are a rare occurrence. During 1955 through 1967, a total of 14 tornadoes were recorded in the 1-degree latitude-longitude square containing the Cape Canaveral site (21). According to Thom (29), the probability, P, of a tornado hitting a point within a degree square is:

$$P = (2.8209)\ t/A$$

where: t = the mean annual frequency of tornadoes within the area,
A = the area of a 1-degree square, square miles.

For the 1-degree square in which Cape Canaveral is located, A is approximately equal to 4,100 square miles and t is approximately 1.08 (i.e., 14 occurrences divided by 13 years). Thus, the probability of a tornado hitting a point within the Cape Canaveral area in any given year is 0.00074, with a return frequency of approximately once every 1,300 years. By comparison, the maximum probability in the United States, based on 1955 through 1967 tornado occurrences, was 0.00588, with return period of 170 years, occurring near Oklahoma City, Oklahoma.

Extended periods of dry weather can occur in any season, but are most common in spring and fall. Dry periods in April and May are generally of shorter duration than those in fall.

Prevailing winds are generally from the north or east, except in March, when northerly winds prevail. Windspeeds are usually between 10 and 15 miles per hour in the afternoon, and 5 and 10 miles per hour at night.

2.1.1.2 Site Specific--

A summary of general climatology of Cape Canaveral is presented in Table 2.1-1. The climate of CCAFS is consistent with that described in Section 2.1.1.2. Mean temperatures range from the low 60s (°F) in the winter months to the low 80s in the summer months. Precipitation is moderately heavy with an average annual rainfall of 45.2 inches. Rainfall varies from averages of 1.4 inches during April to 6.9 inches during September.

The spring and summer months are characterized by southerly and easterly winds, the fall by northerly and easterly winds. During the winter, the predominant winds are north and northwesterly. Wind roses for the CCAFS area are presented in Figures 2.1-1 through 2.1-5. The seabreeze and land breeze phenomena occur commonly during summer and infrequently in winter. The seabreeze occurs during the day due to unequal solar heating of the air over land and over ocean. Land breeze occurs at night when air over land has cooled to a lower temperature than that over the sea. Temperature inversions occur infrequently (approximately 2 percent of the time).

2.1.2 Air Quality

Air quality at CCAFS is considered good, primarily because its distance from major sources of pollution. Air quality at CCAFS is influenced primarily by industrial and private sources located outside of CCAFS. There are no Class I or nonattainment areas (for ozone, NO_x, SO_2, lead, CO, and particulates) within 100 km of CCAFS, except Orange County, which is a nonattainment area for ozone.

Under normal atmospheric conditions, prevailing winds prevent significant concentrations of air pollutants from being transported from offsite sources to CCAFS. One exception occurs during periods when an inversion overlay is in effect. An inversion overlay causes diffusion and dispersion to be inhibited, resulting in a visible trail of pollutants directly from the offsite source to the downwind section of the county.

Table 2.1-1. General Climatology of Cape Canaveral

Parameter	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Wind													
Prevailing*	NW 8	N 8	N 9	ESE 8	E 8	E 7	S 6	E 6	E 7	E 8	NW 8	NW 7	E 7
Cross Wind (20 kts/hr)	1	3	2	2	3	1	1	2	10	7	2	1	35
Temperature													
Extreme Maximum	84	87	88	94	95	98	96	97	94	92	89	85	98
Mean Maximum	69	69	74	78	82	86	88	87	86	81	75	70	79
Mean	60	60	65	70	75	79	81	81	80	75	68	62	71
Mean Minimum	52	51	57	62	67	72	73	73	73	68	60	53	63
Extreme Minimum	19	25	29	34	44	53	55	64	59	40	31	25	19
Relative Humidity													
Mean (percentage)	80	79	77	75	77	81	83	84	82	78	78	79	80
Precipitation													
Days with Measurable Precipitation	10	10	11	8	11	14	14	14	18	16	11	11	148
Days with Precipitation (>0.005 inches)	7	8	9	5	7	12	11	10	14	12	7	7	109
Monthly Maximum (inches)	6.9	7.8	11.3	7.8	7.10	19.10	12.8	12.1	21.0	14.9	8.8	5.9	21.0
Monthly Mean (inches)	2.6	2.9	2.9	1.4	2.9	5.5	5.1	5.1	6.9	4.7	3.2	2.0	45.2
Monthly Minimum (inches)	T	0.4	0.4	T	T	0.4	0.4	1.1	1.6	0.5	T	0.3	T
24-Hour Maximum (inches)	4.6	3.17	5.62	5.13	3.0	4.3	3.57	5.81	6.86	6.37	5.89	2.76	6.86
Thunderstorms													
Days with Thunderstorms	1	2	3	3	8	13	16	14	10	4	1	1	76
Average Number of Hours	1	2	7	6	16	32	44	45	20	7	3	1	184
Fog													
Days with Fog	9	7	7	4	3	2	2	2	2	3	6	7	54
Average Number of Hours	43	33	21	10	7	4	2	4	4	8	19	35	190

*N = North, NNW = North-northwest, NW = North, etc.

Source: ESE, 1985.

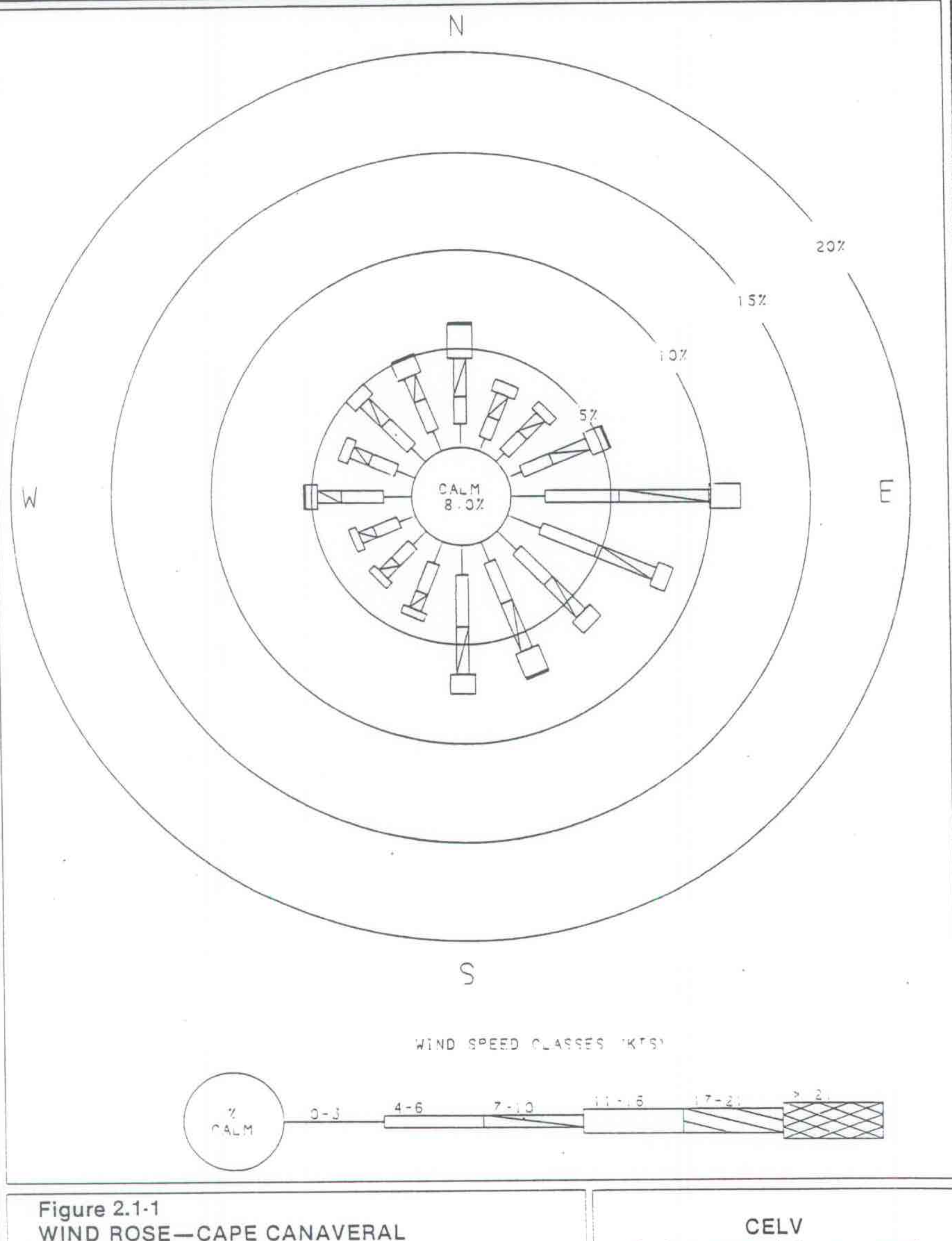

Figure 2.1-1
WIND ROSE—CAPE CANAVERAL
1968-1978 ANNUAL

SOURCE: ESE, 1985.

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Environmental Assessment
Cape Canaveral Air Force Station

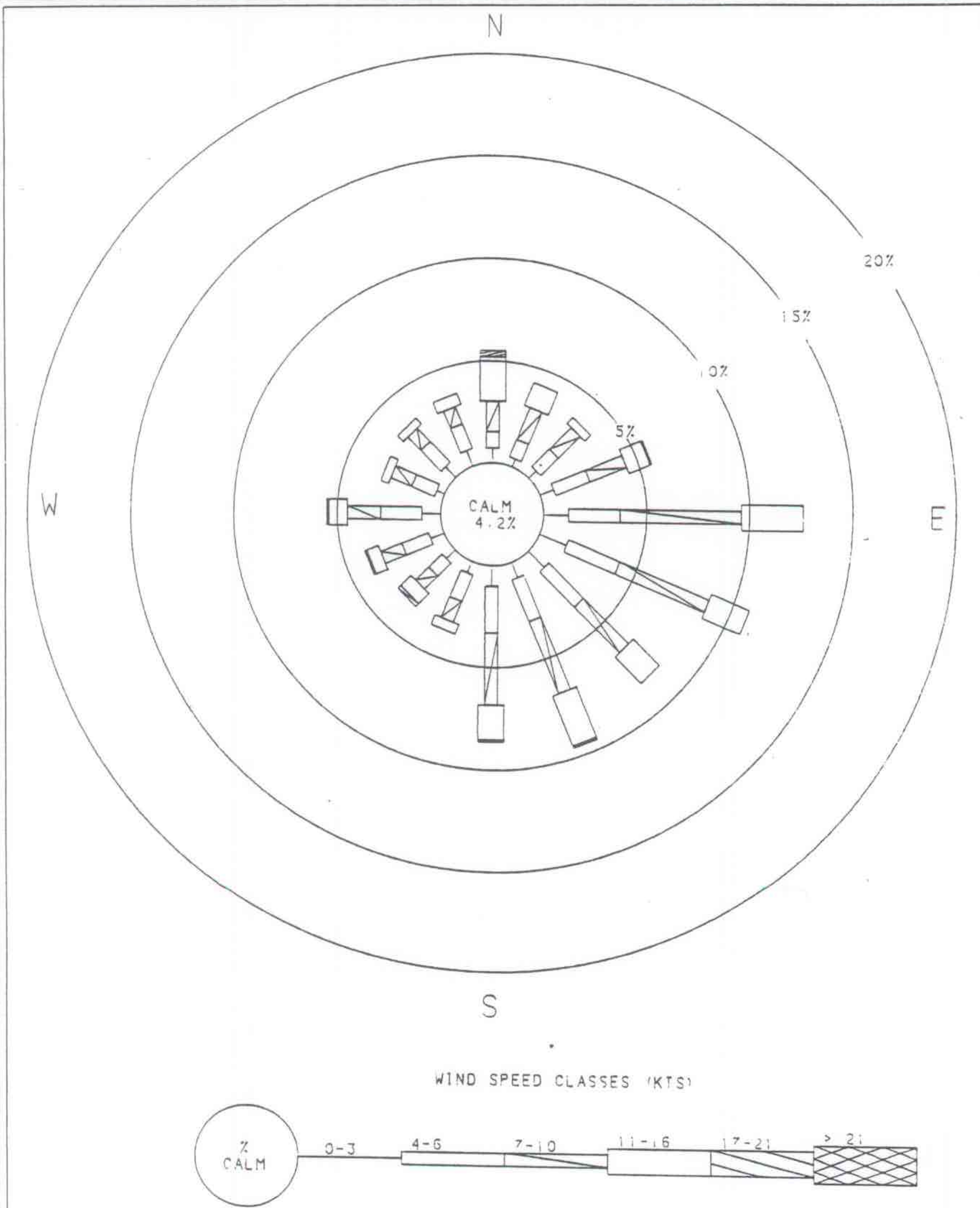

Figure 2.1-2
WIND ROSE-CAPE CANAVERAL,
APRIL 1968-1977
SOURCE: ESE, 1985.

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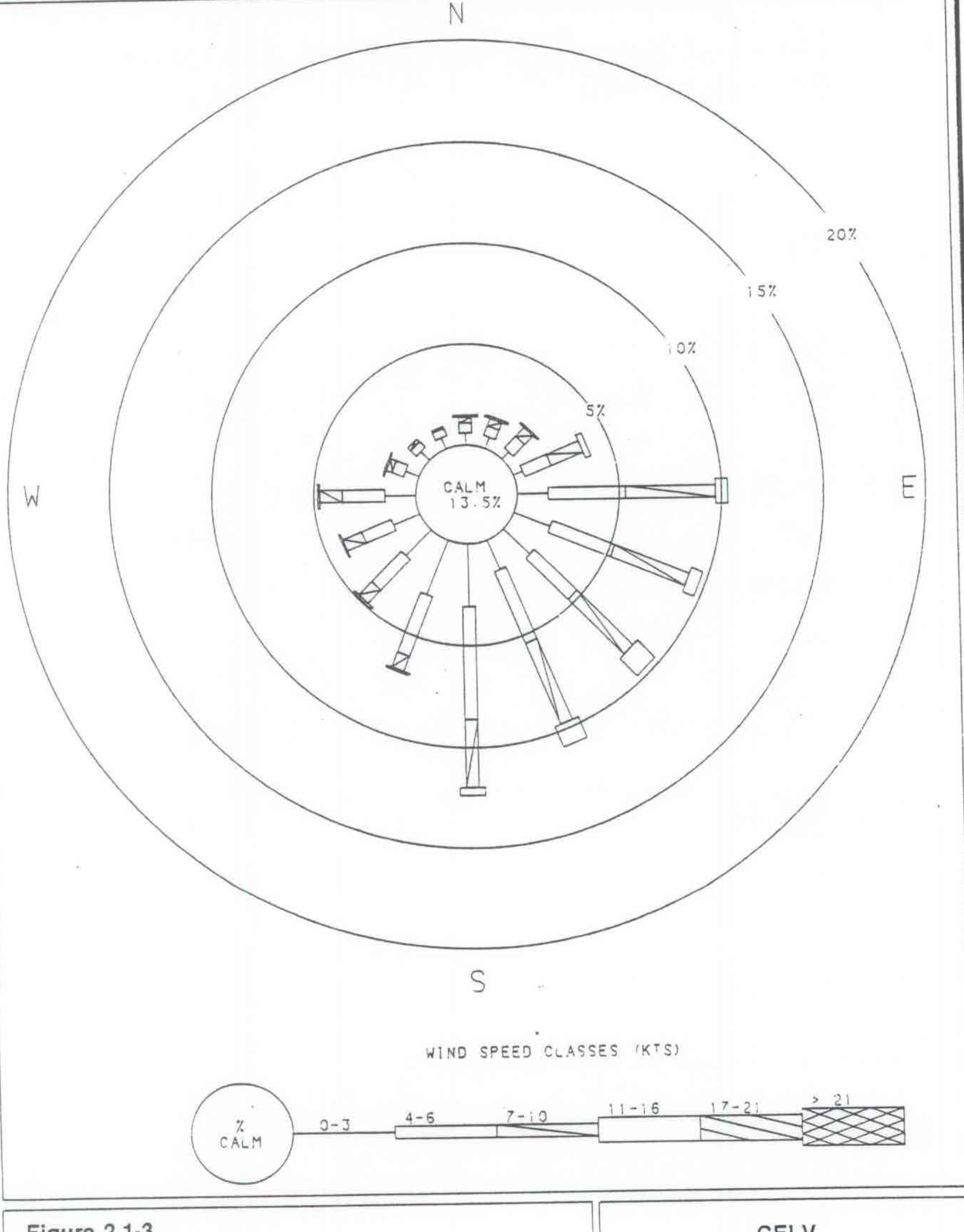

Figure 2.1-3
WIND ROSE-CAPE CANAVERAL,
JULY 1968-1977
SOURCE: ESE, 1985.

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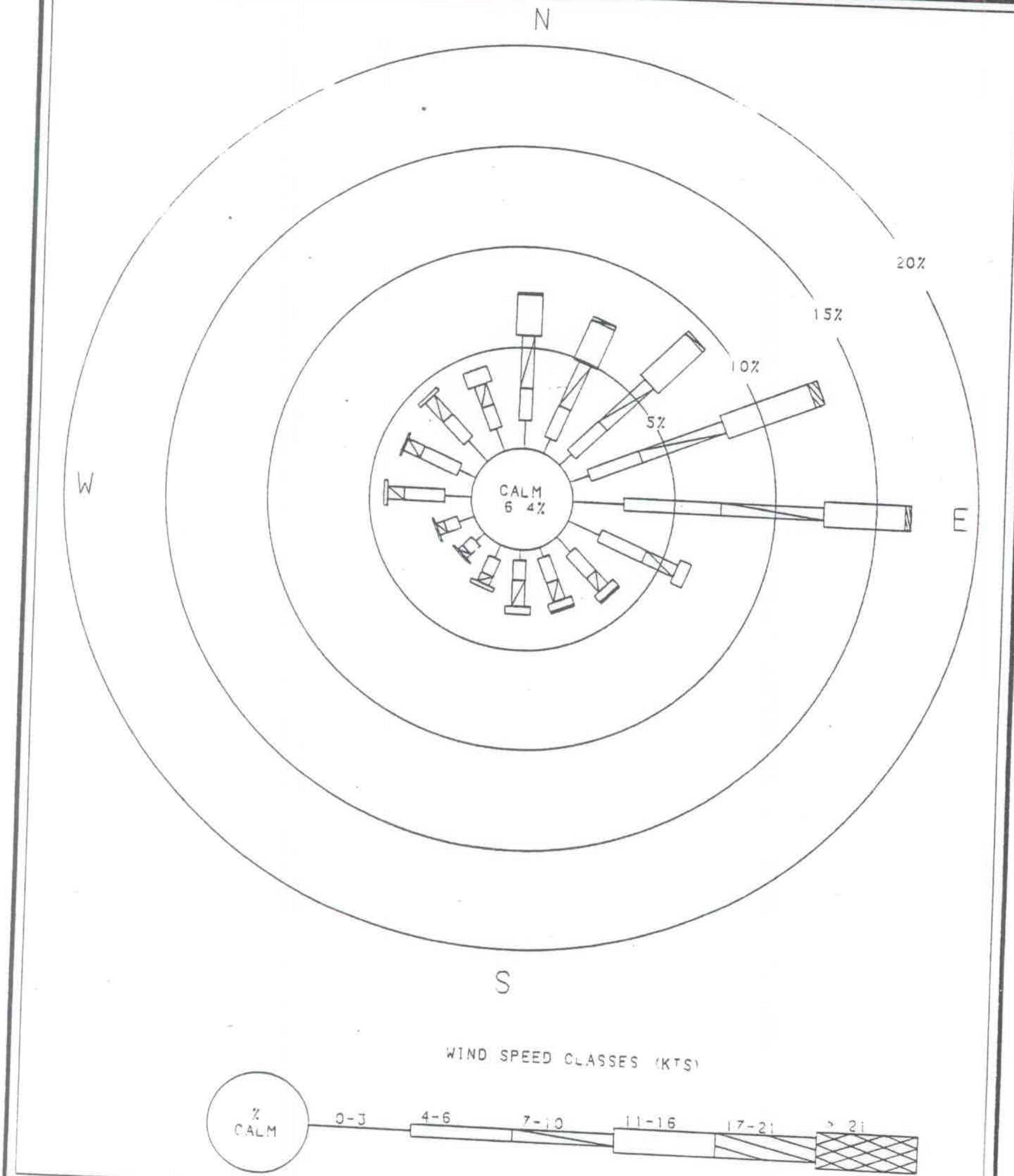

Figure 2.1-4
WIND ROSE—CAPE CANAVERAL
OCTOBER 1968-1977

SOURCE: ESE, 1985.

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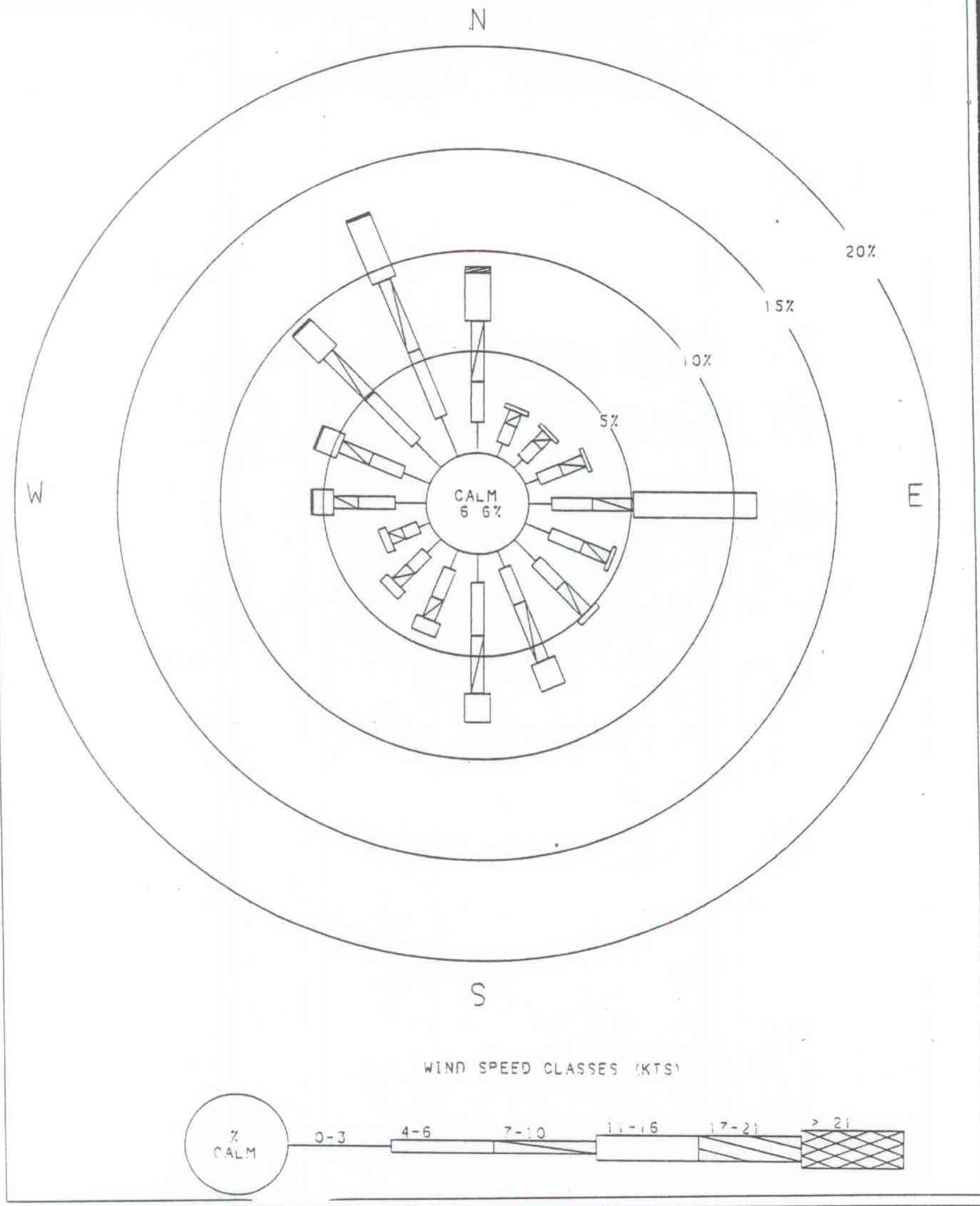

Figure 2.1-5
WIND ROSE—CAPE CANAVERAL
JANUARY 1969-1978

SOURCE: ESE, 1985.

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Cape Canaveral Air Force Station

Air quality monitoring equipment on Cape Canaveral (including the capability to measure toxic gases generated during launches along with state air quality measurements have provided data confirming the absence of major pollutants in the CCAFS area (17).

Air emissions and impacts of the Titan 34D7 vehicle to be used in the CELV program are similar to those described for the Titan III vehicles in the 1975 Environmental Impact Statement (EIS) (31). The Titan III, the current Titan 34D, and the proposed Titan 34D7 vehicles use the same types of propellants. As with the Titan 34D, the Titan 34D7 relies on two SRMs for lift-off. Stage 1, the first liquid stage of the Titan 34D7 vehicle, will not be ignited until approximately 115 seconds into flight. Tables 2.1-2 and 2.1-3 show the products of combustion expected from both the solid and liquid fuel stages. Products of combustion include compounds or molecular fragments which are not stable at ambient conditions or which react with ambient oxygen leaving only those products indicated in significant quantities.

The quantities of propellant used in the Titan 34D7 vehicle are compared in Table 1.1-1 to the quantities used in the Titan IIIC and Titan 34D vehicles. Titan IIIC launch vehicles were launched from Launch Complex 41 until 1977 (33). The Titan 34D was never launched from Launch Complex 41, but rather they are currently launched from Launch Complex 40 at CCAFS and from Vandenberg Air Force Base (VAFB), California. The discussions of air emissions are based on the 1975 EIS. The quantitative results of the 1975 EIS are scaled to account for the differing quantities of propellants used by the Titan 34D7 vehicle.

2.1.2.1 Description of Emissions--

The majority of the emissions resulting from the CELV program are produced from the Titan 34D7 vehicle during launch. Of the major detectable exhaust products produced by the vehicle, aluminum oxide (Al_2O_3), carbon monoxide (CO), hydrogen chloride (HCl), and nitrogen oxides (NO_x) are recognized as air pollutants presenting

Table 2.1-2. Products of Combustion at Nozzle Exit Plane Solid Rocket Motors

Products of Combustion	Weight Fraction
H^+	0.0002
C^-	0.0022
CH^-	0.0002
<u>HCl</u>	0.2055
H_2O	0.0711
H_2	0.0244
CO	0.2775
<u>CO_2</u>	0.0248
<u>N_2</u>	0.0827
$AlCl_3$	0.0089
<u>Al_2O_3</u>	0.3010

Note: It is expected that at altitudes less than 125,000 ft, only those underlined products of combustion will be detectable in significant quantities because of instability of molecular fragments and/or post-burning of the other materials in air of the lower atmosphere.

H^+ = Hydrogen cation
C^- = Carbon anion
CH^- = Ionized hydrocarbon
H_2O = Water
H_2 = Hydrogen molecule
CO_2 = Carbon dioxide
N_2 = Nitrogen molecule
$AlCl_3$ = Aluminum chloride

Source: USAF, 1975.

Table 2.1-3. Products of Combustion at Nozzle Exit Plane Liquid Fuel Engines (N_2O_4/A-50) (Stage 1 ignited approximately 115 seconds into flight)

Products of Combustion	Weight Fraction
CO	0.025
$\underline{CO_2}$	0.181
H	0.000
$\underline{H_2}$	0.002
$\underline{H_2O}$	0.350
$O^=$	0.000
OH^-	0.004
O_2	0.007
$\underline{N_2}$	0.411
NO_x	0.019

Note: It is expected that at altitudes less than 125,000 ft, only those underlined products of combustion will be detectable in significant quantities because of instability of molecular fragments and/or post-burning of the other materials in air of the lower atmosphere. The location of the CELV Titan 34D7 will be over the Atlantic Ocean approximately 30 miles from Launch Complex 41 when Stage I ignites.
$O^=$ = Oxygen ion.
OH^- = Hydroxide ion.
O_2 = Oxygen molecule.

Source: USAF, 1975.

potential hazards. It is anticipated that CO will oxidize to carbon dioxide (CO_2) due to the initial high temperature and abundance of oxygen. However, to be conservative, CO will be treated as if it did not oxidize. The ground level impacts from NO_x produced from the liquid fuel propellant is expected to be negligible since the liquid fuel stage (Stage 1) is ignited 115 seconds into the launch cycle. The 115 seconds equates to the vehicle being approximately 30 miles downrange and at an altitude of approximately 160,000 ft. Thus, air emissions of concern during launch are produced only by the SRMs as the Titan 34D7 vehicle main engines will not fire until the vehicle is well away from the launch complex.

Other emissions resulting from CELV operations include fuel (Aerozine 50), and nitrogen tetroxide (N_2O_4) vapors. In the past, fuel and oxidizer vapors were vented directly to the atmosphere through 200-ft vent stacks during loadings, unloadings, routine maintenance, and emergencies. As part of the renovation of Launch Complex 41, air pollution control devices will be installed at the fuel and oxidizer propellant handling systems at Launch Complex 41 for control of the respective emissions.

The proposed Aerozine 50 air pollution control devices consist of a fuel vapor incinerator system (FVIS). A schematic diagram of the FVIS is presented in Figure 2.1-6. Vapors resulting from bulk propellant transfer, system checkout (ready storage vessel, and Stage I and II fuel tank pressurizations), and post launch fueling system purgings will be collected and burned in a propane fired incinerator. Similar FVIS systems are currently in use in deactivation of the Titan II [an intercontinental ballistic missile (ICBM)] at various locations throughout the country. The Titan II utilized the same liquid propellants as the Titan 34D7.

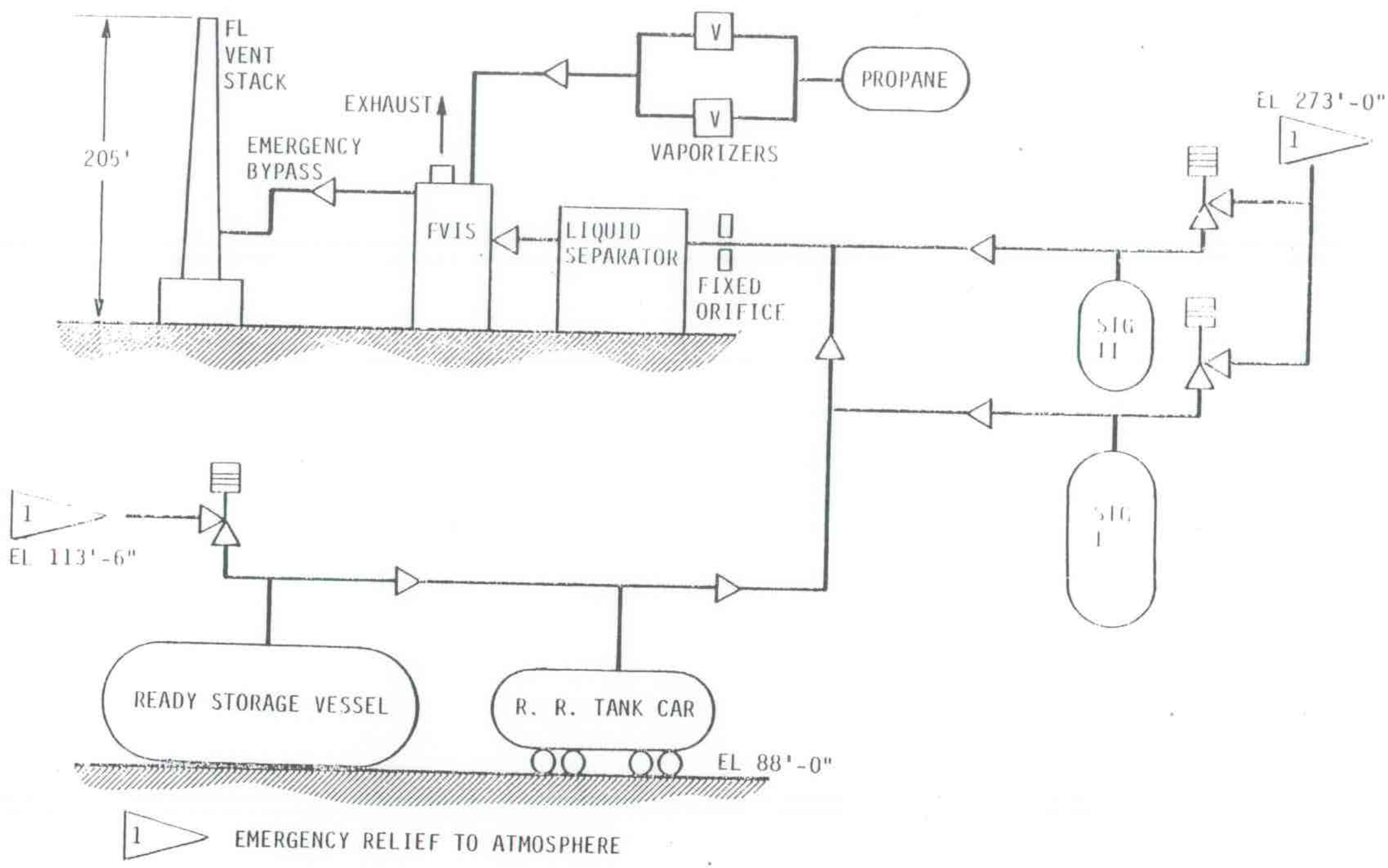

Figure 2.1-6
LAUNCH COMPLEX-41 FUEL VENT SYSTEM WITH FVIS
SOURCE: Martin Marietta, 1985.

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Environmental Assessment
Cape Canaveral Air Force Station

The proposed N_2O_4 air pollution control device consists of an oxidizer vapor scrubber system (OVSS). A schematic diagram of the proposed OVSS is presented in Figure 2.1-7. The OVSS will use four packed towers in series with a 25 percent sodium hydroxide (NaOH) neutralizing liquor flowing countercurrent to the oxidizer vapors. A similar OVSS has been permitted as best available control technology (BACT) in the State of California.

Releases of small concentrations of fuel and oxidizer may occur as a result of scheduled post launch maintenance when fuel and oxidizer filters are replaced. These releases occur only after the propellant lines have been purged with nitrogen gas to reduce emissions to the lowest practical level. There is no way to completely eliminate these small releases as the system must be opened to change the filters. These small releases are not expected to result in significant adverse impact to the environment.

In the event of an emergency, fuel and oxidizer may vent directly to the atmosphere. Emergency releases could occur during the rupture of part of the propellant loading system. No uncontrolled venting of vapors is expected due to over-filling or over-pressurizing of the RSV and the Stage I and II storage vessels. Redundant flow meters and redundant automatic shutdown devices on the propellant loading system prevent over-filling. Automatic pressure monitoring devices on the tanks and feed system prevent over-pressurization. Since operational start-up of the Titan program at CCAFS in 1963, no emergency releases of the entire fuel or oxidizer volume have occurred. However, one controlled release of N_2O_4 occurred in approximately 1970 at Launch Complex 41. This release occurred when approximately 1,000 gallons of N_2O_4 was slowly released to the flame bucket and immediately neutralized.

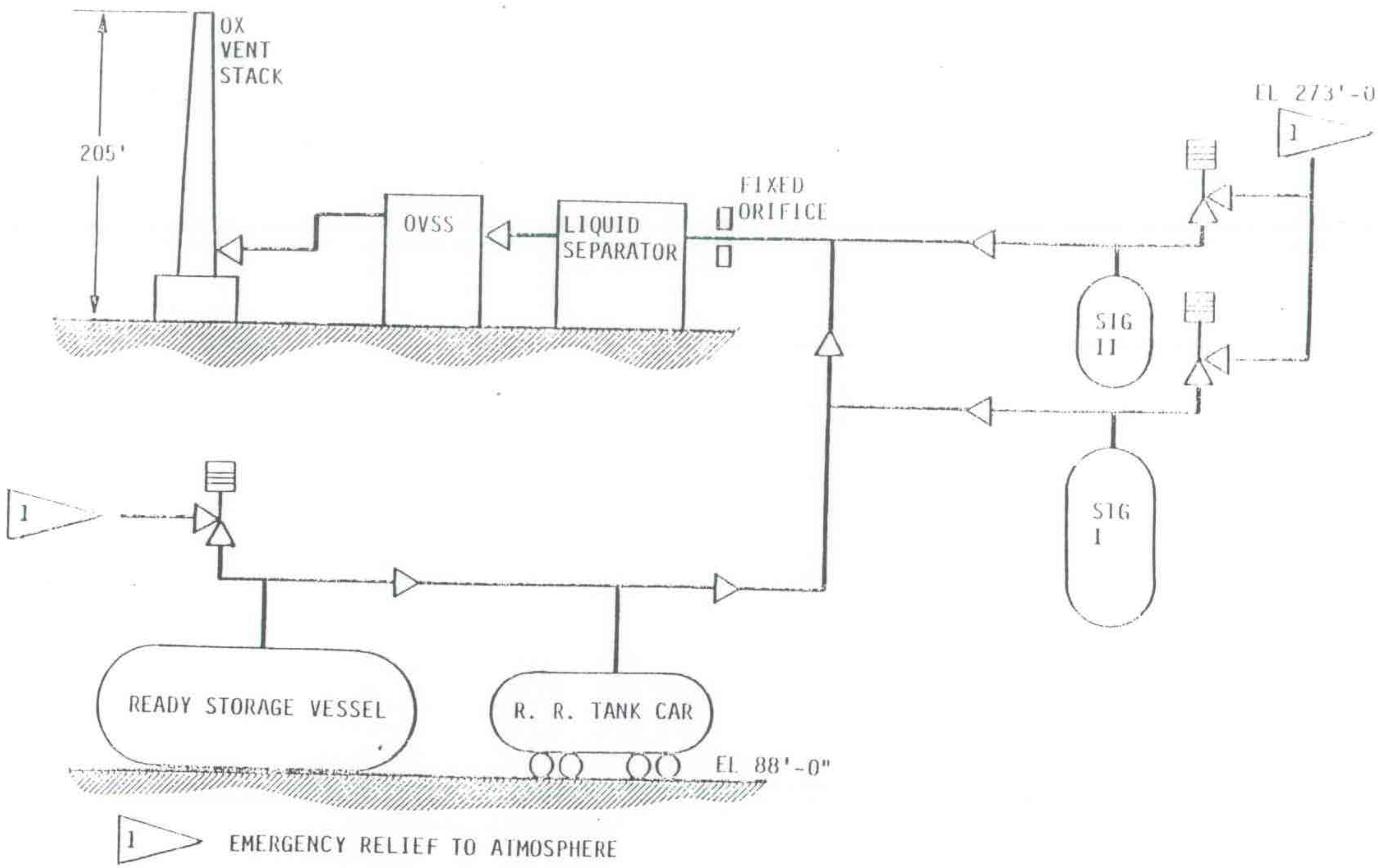

Figure 2.1-7
LAUNCH COMPLEX-41 OXIDIZER VENT SYSTEM WITH OVSS
SOURCES: Martin Marietta, 1985.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

In the unlikely event of a vehicle destruction on the pad, failure in flight, or a commanded vehicle destruct, liquid propellant tanks and SRM cases are ruptured. Under these circumstances, most of the released liquid propellants would ignite and burn due to their hypergolic nature. The sudden reduction in chamber pressure caused by rupturing SRM cases is designed to extinguish most of the solid propellants and only a portion will continue to burn. No information is available concerning the products of combustion formed in a failure mode situation, nor the extent to which the propellants are consumed.

In summary, emissions of air pollutants from CELV operations may arise from prelaunch operations, including bulk propellant transfer and system check out, launch operations, post-launch operations involving fueling system purging, scheduled and unscheduled propellant loading system component changeout including changes of filters, on-pad accidents, or in-flight accidents at which propellants are burned or released to the environment.

Impacts--In a normal launch, exhaust products are distributed along the trajectory path. These exhaust products are shown in Tables 2.1-2 and 2.1-3. Due to the rate of acceleration of the vehicle and the staging processes, the quantities of exhaust gas emitted per unit length of the trajectory are greatest at ground level and decrease continuously. The quantity of exhaust gases in the first 2,500 ft of the atmosphere is most likely to be detectable and, in the case of SRMs, has the potential for local short-term measurable polluting of the atmosphere with HCl near ground level. It has been observed from many launches of the Titan and other boosters that the portion of the exhaust plume that persists for more than a few minutes is that portion emitted during the first few seconds after ignition and which is concentrated in the pad area and referred to as the ground cloud. Because the ground cloud may persist near ground level for a short period, the rate of dispersion of that cloud is of significance with respect to the near-field environment.

The diffusion model used in (31) to calculate peak ground level concentrations assumed an instantaneous elevated volume source. The vertical distribution of the exhaust products was initially assumed to be Gaussian about the actual stabilized height of the exhaust ground cloud. The model required that an effective source height for the HCl be determined within the surface mixing layer. A spherical cloud with a trivariate Gaussian distribution of the material within the mixing layer was assumed to be centered at the effective height.

The predicted concentrations were considered to represent peak ground level values occurring along a narrow path as the ground cloud moves downwind from the launch pad; the actual duration of the exhaust cloud over any given ground point is of short duration (minutes).

The 1975 EIS analysis of the Titan IIIC launch indicated that HCl concentrations along the path of the ground cloud may reach as high as 11 parts per million (ppm) for 5 minutes at approximately 5 kilometers (km) downwind, and HCl concentrations would not exceed 5 ppm at any time beyond 11 km downwind (Figure 2.1-8).

Because the nearest uncontrolled area is 16 km from the launch site, it is not expected that the general population will be exposed to HCl concentrations greater than the current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 5 ppm (8 hrs time-weighted average). No problems regarding HCl revolatilization (release of gaseous HCl from a solid or liquid phase into the atmosphere) are expected due to the distance to uncontrolled areas. Appropriate safety measures are taken to ensure that OSHA PEL are not exceeded by personnel at the launch pad.

Using the same predictive modeling techniques that were used for HCl, the 1975 EIS describes the projected CO and particulate Al_2O_3 impacts from a Titan IIIC launch. CO concentrations are not predicted to exceed the National Ambient Air Quality Standards (NAAQS) of 35 ppm

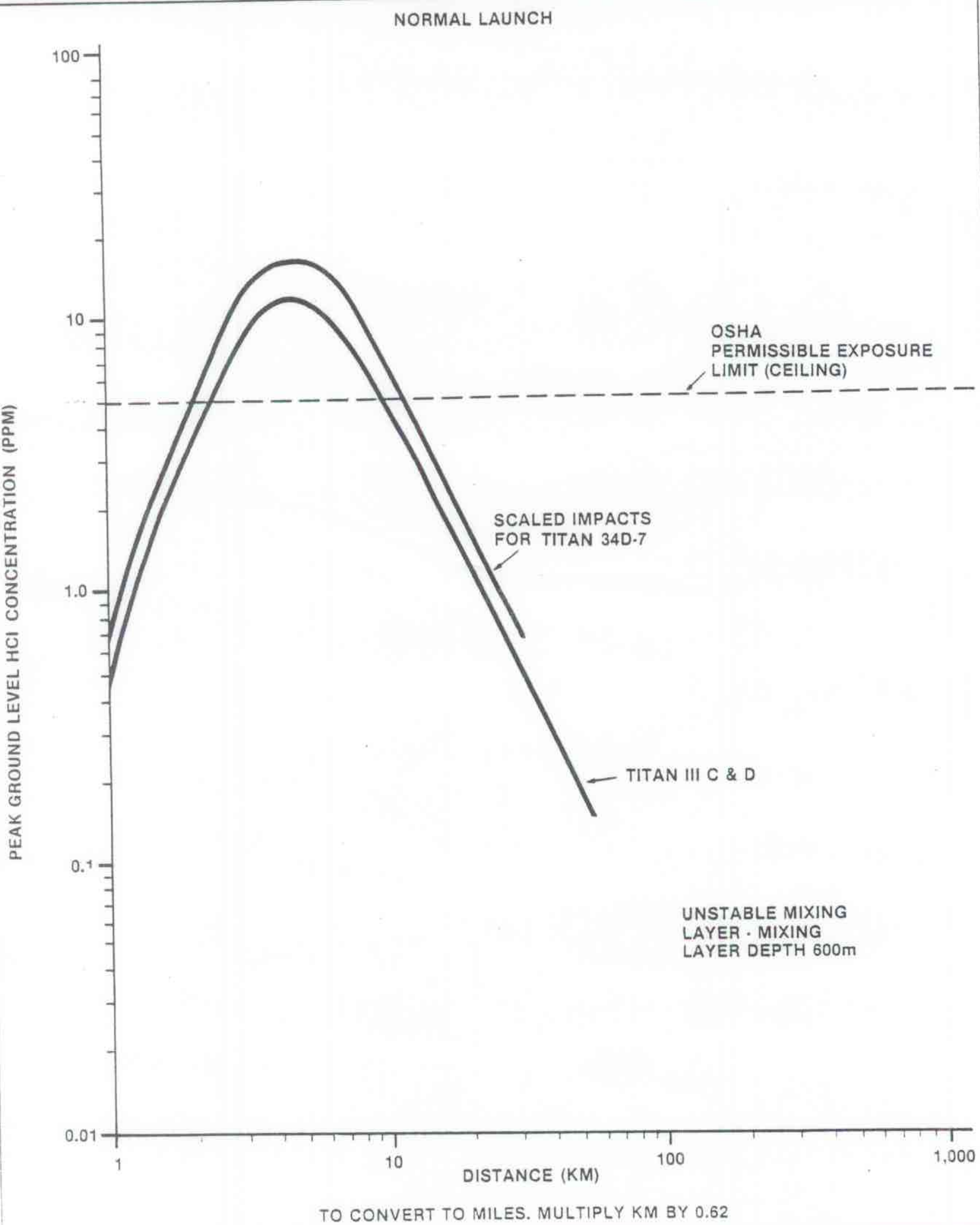

Figure 2.1-8
ESTIMATED PEAK GROUND LEVEL HCl CONCENTRATION DOWNWIND FROM LAUNCH SITE
SOURCE: FEIS. 1975.

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Environmental Assessment
Cape Canaveral Air Force Station

(1-hr average) outside of the Launch Complex 41 boundaries. Except for brief excursions during lift-offs, the CO concentration due to a Titan IIIC launch was predicted to be below 9 ppm, the NAAQS 8-hr time weighted average (Figure 2.1-9). Based on these predictions, the CO impacts due to a Titan 34D7 launch are not expected to exceed NAAQS since CO generation rates of the former are expected to be similar to that of the Titan IIIC.

The peak concentrations of particulate Al_2O_3 due to a Titan IIIC launch are predicted to be 28 milligrams per cubic meter (mg/m^3) approximately 5 km from the launch site (Figure 2.1-10); the peak concentration would be present for only 2 to 15 minutes in any location depending on wind conditions. The SRMs used on the Titan 34D7 will be similar in composition to those used on the Titan IIIC, but will contain 33 percent more fuel. Therefore, the peak concentration of Al_2O_3 from the launch of a Titan 34D7 is predicted not to exceed 38 mg/m^3 at a distance of approximately 5 km from the launch site. The NAAQS for particulate matter, 150 micrograms per cubic meter (ug/m^3) 24-hr average, will not be exceeded by Titan 34D7 launches due to the short, intermittent durations of increased particulate concentrations in the immediate vicinity of the launch complex.

In late 1960, USAF initiated a series of activities to determine the potential toxicity problems that would be encountered both at CCAFS and VAFB with the use of the hypergolic liquid propellants N_2O_4 and Aerozine 50 aboard Titan launch vehicles. These actions were directed toward assuring safe range operation. Although the Aerozine 50 mixture is considered to be more toxic than N_2O_4, the vapor pressure of the oxidizer (N_2O_4) is higher than that of the fuel (Aerozine 50), resulting in a higher rate of evaporation. Therefore, in considering possible problems associated with propellant spills, the more severe case wherein N_2O_4 is spilled is used.

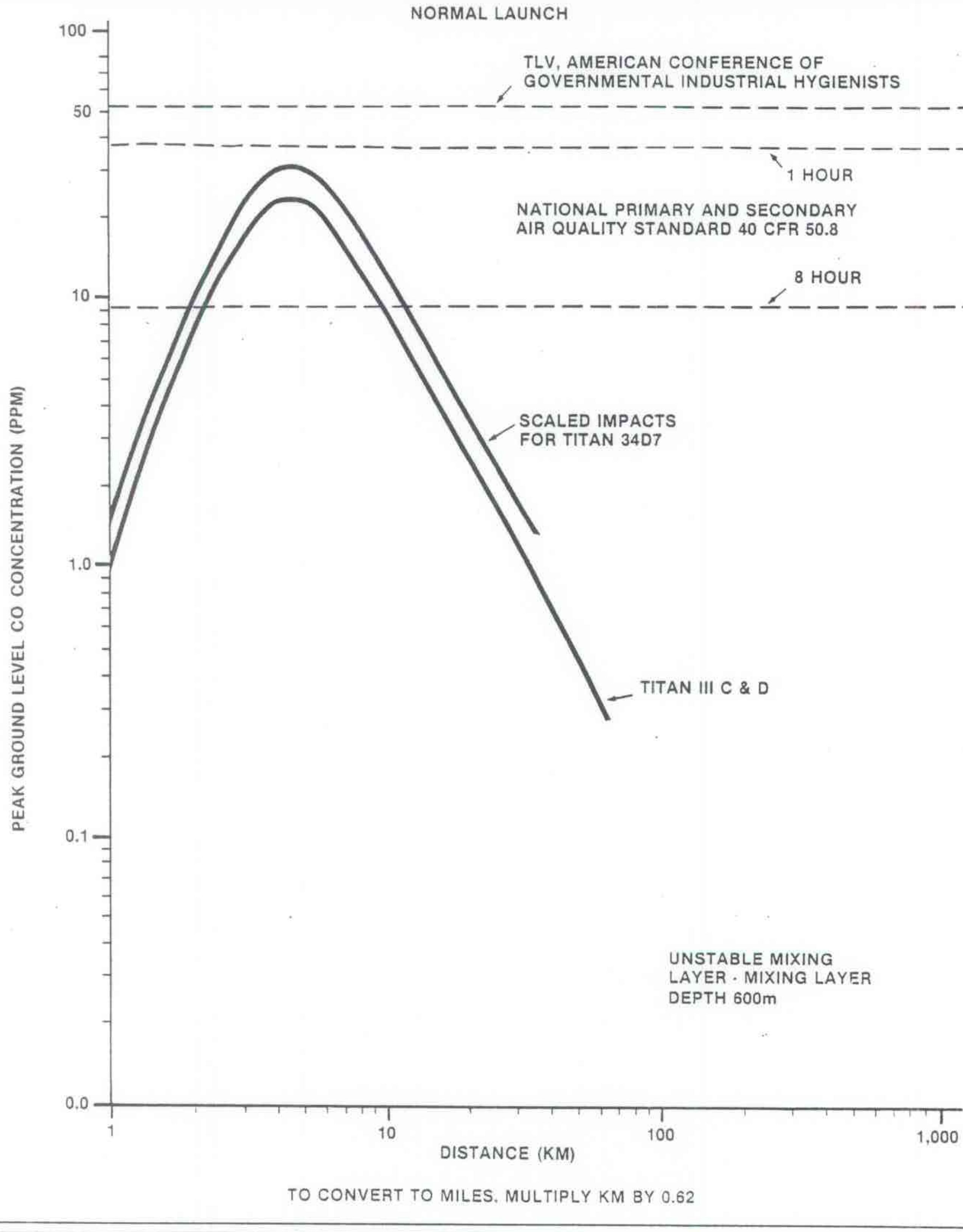

Figure 2.1-9
ESTIMATED PEAK GROUND LEVEL CO CONCENTRATION DOWNWIND FROM LAUNCH SITE

SOURCE: FEIS, 1975.

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Environmental Assessment
Cape Canaveral Air Force Station

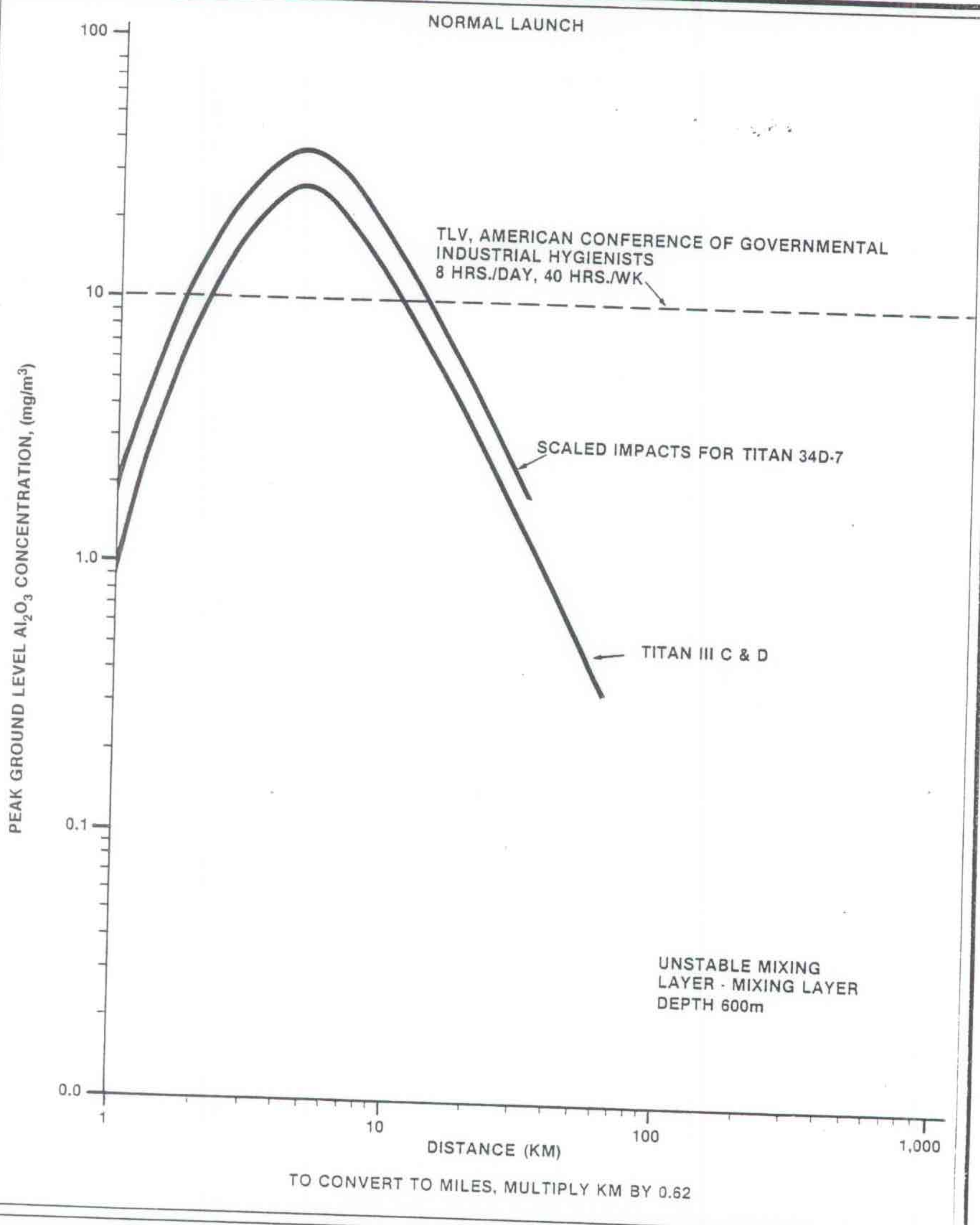

Figure 2.1-10
ESTIMATED PEAK GROUND LEVEL Al_2O_3 CONCENTRATIONS DOWNWIND FROM LAUNCH SITE

SOURCE: FEIS, 1975.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

A program was performed at the Air Force Rocked Propulsion Laboratory to assess the toxic source strength resulting from a liquid propellant spill or a missile failure. Another program was initiated with the Air Force Cambridge Research Laboratory to perform an experimental diffusion program to evaluate the dilution of the propellant vapors in the atmosphere. An outgrowth of these two programs was the establishment of a Weather Information Network Display (WIND) system for both east and west coast launch bases. The WIND system is a network of meteorological observation towers ranging in height from 6 to 300 ft which are located at representative locations throughout CCAFS and VAFB. The meteorological data observed by these respective stations are transmitted to a central receiving station where the data are processed by a computer and presented on a scaled map display panel. Weather parameters as observed at each of the stations are displayed at discrete intervals. In addition, these data are called up from the computer for use in meteorological prediction programs.

The test programs conducted at Air Force Rocket Propulsion Laboratory provided the needed data to determine evaporation rates from the surface of spilled liquid propellants. It was found that the vapor pressure of the fluid, the surface area, the wind velocity, and the wetness of the surface on which the propellants were spilled all contribute to the evaporation rate. These data were considered in the subsequent test program by Cambridge Research Laboratory and an empirically derived prediction equation was developed so that it was possible to predict the downwind distance to a safe concentration level resulting from a propellant spill. The prediction model makes use of measured weather parameters derived from the WIND system.

The most critical condition that can be encountered is that of a total spill of the full quantity of N_2O_4 aboard a launch vehicle onto the ground into a pool. This condition is always assumed when evaluating weather conditions prior to propellant transfers. Under nighttime adverse weather conditions, it was predicted that a plume from a spill involving a Titan IIIC may reach as far as 2.5 miles before NO_x concentrations are lowered to 5 ppm, the current PEL, and would travel several kilometers further before being lowered to 1 ppm, athe NIOSH recommended ceiling. Activation of a water deluge to effect rapid dilution of the spill are expected to reduce the evaporation rate substantially so that exposure to concentrations above the NIOSH ceiling would be limited to approximately 10 minutes in areas not in the immediate vicinity of the spill. Because of the deluge system's ability to reduce the evaporation rate and the design of the pad to prevent spreading of the liquid, impacts from a spill involving a T34D7 vehicle are expected to be similar to those predicted for a Titan IIIC even though more liquid fuel is stored on a T34D7.

Taking into account the direction of the wind, if the critical distance were to include an uncontrolled area, onbase or offbase, propellant loading would be deferred. Those personnel actually involved in the propellant transfer are provided with protective clothing and breathing equipment. All those persons not involved in the transfer operation are excluded from this area.

NO_x may enter the atmosphere through three other sources. One is from the thrust vector control system. A second source may be the exhaust products from the rocket engines. In both cases, the total quantity emitted is small compared to the spill previously discussed. It becomes necessary from time to time that the liquid propellant storage vessels or flight vehicle tanks be vented to maintain proper operating pressures. This third source is also small and infrequent.

2.1.3 Geology

Launch Complex 41 is located on the northern-most portion of CCAFS. The latter is located on barrier island composed of relict beach ridges formed by wind and waves. This island parallels the shoreline separating the Atlantic Ocean from the Indian River, Indian River Lagoon, and Banana River. The island is approximately 4.5 miles wide at the widest point. The land surface ranges from sea level to 20 ft above mean sea level (msl) at its highest point. The complex is underlain at depth by a series of limestone formations several thousand feet thick. The upper few hundred feet consists of formations constituting the Floridan Aquifer. The formations, from oldest to youngest, respectively, are the Avon Park and the Ocala. Overlying the artesian Floridan Aquifer are the confining beds of the Hawthorn Formation. The confining beds are overlain by Pleistocene and Recent Age unconsolidated deposits. Characteristics of the stratigraphic units underlying CCAFS are listed in Table 2.1-4, and a geologic cross section is presented in Figure 2.1-11.

2.1.4 Soils

Soils in the area of Launch Complex 41 have been mapped by the U.S. Department of Agriculture Soil Conservation Service (SCS). Several soil types have been identified by SCS in the vicinity of Launch Complex 41. These soil types are Canaveral Complex, Palm Beach sand, Pompano sand, and tidal marsh. The pattern of soil types underlying CCAFS is shown in Figure 2.1-12, and the engineering properties of these soil types are listed in Table 2.1-5. The soils primarily are highly permeable, fine-grained sediments typical of beach and dune deposits. Based on examination of well and soil boring logs from CCAFS, the near-surface stratigraphy is fairly uniform, consisting of Pleistocene Age sand deposits that underlie the installation to depths of approximately 100 ft. Additional fill material has been used within the boundary of Launch Complex 41 to increase overall elevation above sea level.

2.1.5 Hydrology

2.1.5.1 Ground Water--

Ground water at CCAFS occurs under confined (artesian) and unconfined (nonartesian) conditions. Confined ground water is located in the Floridan Aquifer, which serves as the principal ground water source in the coastal lowlands. The Floridan Aquifer is composed of numerous

Table 2.1-4. Stratigraphic Units Underlying CCAFS

Geologic Age	Stratigraphic Unit	Approximate Thickness (ft)	Lithologic Characteristics
Pleistocene and Recent	Pleistocene and Recent Age Deposits	0-110	Fine to medium sand, coquina, and sandy shell marl.
Miocene and Pliocene	Upper Miocene or Pliocene Age Deposits	20-90	Gray to greenish-gray, sandy shell marl; green clay; fine sand; and silty shell.
	Hawthorn Formation (Aquitard)	10-300	Light green to greenish-gray sandy marl; streaks of greenish clay, phosphatic clay, and phosphorite, interbedded with thin beds of phosphatic sandy limestone.
Eocene	Crystal River Formation*	0-100	White to cream, friable porous coquina in a soft, chalky, marine limestone.
	Williston Formation*	10-50	Light cream, soft, granular, fine-grained, highly fossiliferous marine limestone.
	Inglis Formation*	70+	Cream to creamy white, coarse granular limestone with abundant echinoid fragments.
	Avon Park Limestone*	285+	White to cream, purple-tinted, soft, dense chalky limestone with zones of light brown to gray, hard, porous crystalline dolomite.

* Constitute Floridan Aquifer.

Sources: USGS, 1962; ESE, 1984.

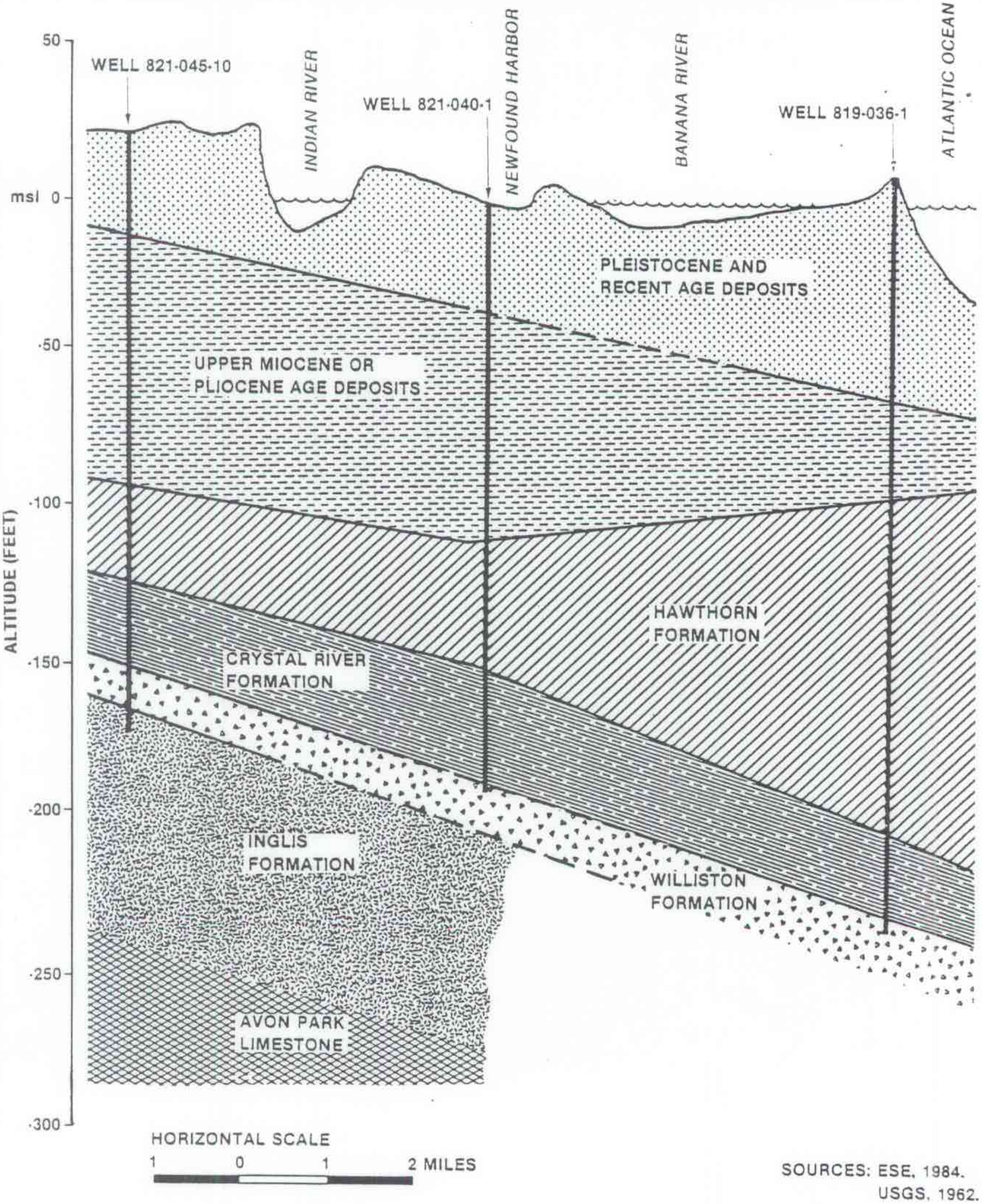

Figure 2.1-11
GEOLOGIC CROSS SECTION

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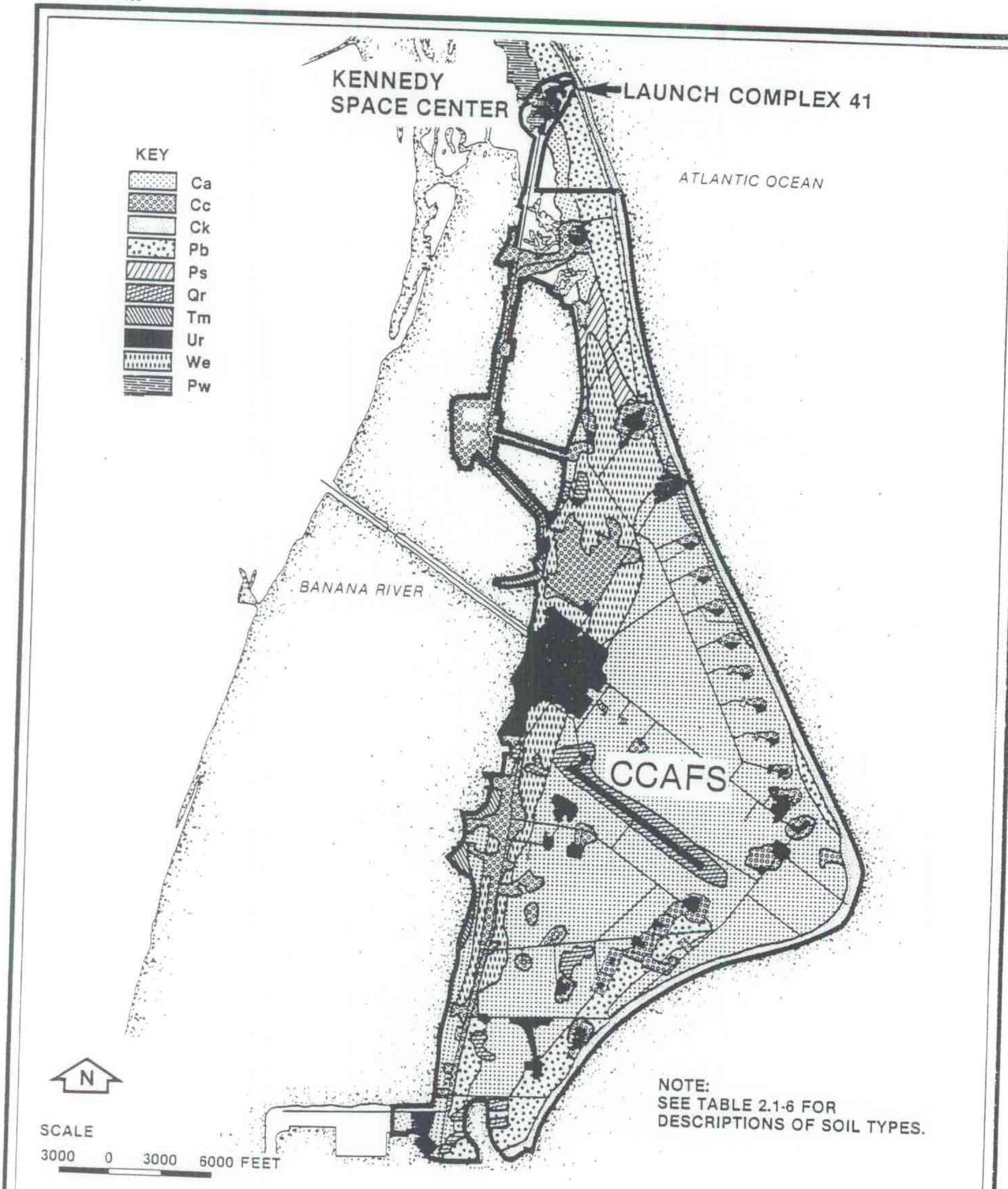

Figure 2.1-12
PATTERN OF UNDERLYING
SOIL TYPES

SOURCES: ESE, 1984.
SCS, 1974.

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Table 2.1-5. Soils Engineering Characteristics

Soil Type	Description	Depth to Bedrock (inches)	Permeability (inches/hr)	Depth to Water (inches)	Flood Hazard (days/year)	Approximate Site Coverage (%)	pH	Cation Exchange Capacity (meq/100 g)*
Canaveral Complex (Ca)	Nearly level to gently undulating, moderately well drained sandy soil with shell fragments; these soils occur on ridges	>120	>20.0	10-40	None	66	ND	ND
Canaveral-Urban Land Complex (Cc)	Canaveral sand and urban land; sand and shell dredged from rivers and impermeable surfaces (i.e., pavement)	>120	>20.0	10-40	None	5	ND	ND
Coastal Beaches (Ck)	Level or gently sloping sand in narrow strips along the Atlantic; this soil is covered with salt water daily	>120	NA	0	Daily	3	ND	ND
Palm Beach Sand (Pb)	Nearly level to gently sloping, excessively drained soil consisting of mixed sand and shell fragments	>120	>20.0	>120	None	5	8.1-8.8	0.5-6.1
Pomello Sand (Ps)	Nearly level, moderately well drained sandy soil on low ridges	>120	0.2->20.0	0-80	None	2	ND	ND
Pompano Sand (Pw)	Nearly level, poorly drained sandy soil on broad flats	>120	>20.0	10-40	None	1	ND	ND
Quartzipsamment (Qr), smoothed	Nearly level to steep sandy soils reworked and reshaped by man; drainage variable	>120	NA	NA	None	3	ND	ND

Table 2.1-5. Soils Engineering Characteristics (Continued, Page 2 of 2)

Soil Type	Description	Depth to Bedrock (inches)	Permeability (inches/hr)	Depth to Water (inches)	Flood Hazard (days/year)	Approximate Site Coverage (%)	pH	Cation Exchange Capacity (meq/100 g)*
Tidal Marsh (Tm)	Nearly level soils regularly covered with salt water; soils are variable from mucky to mixed sand and shell fragments and clays	NA	NA	0	Continuously flooded	1	ND	ND
Urban Land (Ur)	Area covered by more than 60 to 75 percent impermeable material (i.e., pavement)	>120	NA	0-10	NA	5	ND	ND
Welaka Sand (We)	Nearly level, well drained sandy soil on broad ridges	>120	>20.0	40-60	None	10	4.2-8.4	0.2-5.6

* Milliequivalents per 100 grams.
ND = No data.
NA = Not applicable.

Sources: SCS, 1974.
ESE, 1984.

limestone formations several thousand feet thick. Recharge to the Floridan Aquifer occurs primarily in northern and central Florida. The hydraulic head in the Floridan Aquifer is above the land surface, thus producing free flowing conditions when wells are located in this formation. Due to the confining clays of the Hawthorn Formation and artesian conditions of the Floridan Aquifer, potential contamination of this formation in the CCAFS area is very limited.

Although good quality water may be obtained from much of the Floridan Aquifer throughout the state, water from this formation on CCAFS is highly mineralized and is not used for domestic or commercial purposes. Water for domestic and commercial uses in this area is primarily from the shallow unconfined aquifer.

The shallow unconfined aquifer is composed of Recent and Pleistocene Age surface deposits typically 0 to 5 ft below land surface at CCAFS. The unconfined aquifer is recharged by rainfall along the coastal ridges and dunes, with little recharge occurring in the low swampy areas. Once the water reaches the saturated zone, it moves laterally toward the Atlantic Ocean or Banana River (see Figure 2.1-13). The unconfined aquifer formation ranges in depth from approximately 50 ft at the coastal ridge to less than 20 ft in the vicinity of the St. Johns River. The unconfined aquifer below Launch Complex 41 is not used as a water source.

Impacts--Water use at Launch Complex 41 will be limited to deluge water, launch complex washdown and fire suppressant water, and potable water; all water will be supplied by municipal sources. No withdrawal of ground water will be required from wells located on CCAFS. All of the approximate 400,000 gallons of water used during each launch will come from municipal sources.

During vehicle launch, approximately 30 to 40 percent of the deluge water and launch complex washdown and fire suppressant water will be

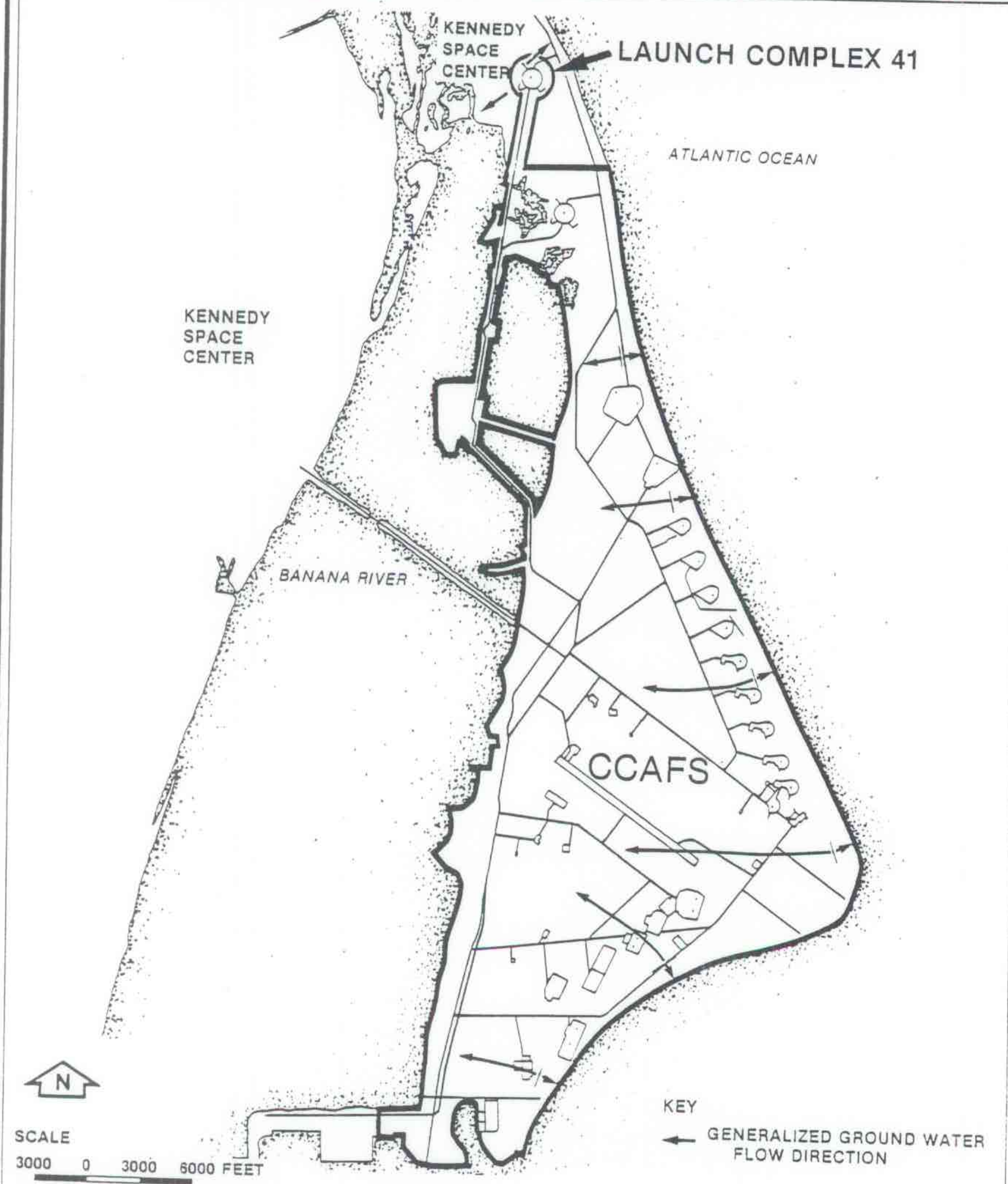

Figure 2.1-13
GENERALIZED GROUND WATER FLOW
DIRECTION IN THE UNCONFINED AQUIFER

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collected in the flame bucket located directly beneath the launch vehicle. The remaining washdown and fire suppressant water will flow directly to the surrounding area. The exact quantity and quality of water that will flow off the launch pad surface and drain directly to grade is not known. However, the only potential contaminants used on the launch pad are fuel and oxidizer. Furthermore, any potential release of these substances would be expected to occur over the flame bucket and would not contaminate the launch pad surface or launch pad runoff. The next launch from Launch Complex 40 will be monitored to determine both the quantity and quality of direct runoff to grade and the water which collects in the flame bucket. Due to the high degree of similarity between Launch Complex 40 and Launch Complex 41, data collected during this monitoring study will be applicable to both sites. Samples of water collected from both the flame bucket and direct runoff to grade from Launch Complex 40 will be analyzed for pH, hydrazine, nitrogen tetroxide, specific conductance, state and Federal primary and secondary drinking water standards, and synthetic organic chemicals listed in Rule 17-22 Florida Administrative Code (FAC), including purgeables, pesticides, base neutral extractables, and acid extractables. If the analyses do not support the assumption that the flame bucket and runoff water is not contaminated, the Air Force will take the appropriate actions to comply with applicable Federal and state regulations.

Sampling and analysis of flame bucket water from subsequent Titan 3407 launches at Launch Complex 41 will be based on the results of the initial flame bucket water analysis. A discussion of the State of Florida ground water discharge permitting and analytical requirements is presented in Section 3.2. If water in the flame bucket meets discharge criteria, it will be discharged to grade within the Launch Complex 41 boundary.

Ground water recharge will result from the overall disposal to grade and subsequent percolation of approximately 300,000 gallons of deluge water and 100,000 gallons of washdown and fire suppressant water at Launch Complex 41 following each launch. Following discharge to grade, the water will percolate into the ground water table and flow in a westerly direction toward the Banana River. No significant adverse impacts are anticipated on ground water hydrology as a result of the proposed activity at Launch Complex 41.

2.1.5.2 Surface Water--
Launch Complex 41 is located on a barrier island which separates the Banana River from the Atlantic Ocean. Numerous sloughs and marshes border Launch Complex 41 to the west. It is estimated that approximately 25 percent of the total land area within 31 miles of the launch site is covered by surface water.

Typical of barrier islands, the drainage divide is the dune line just inland from the Atlantic Ocean. Little runoff is naturally conveyed to the ocean. At least 90 percent of the runoff percolates or flows westward to the Banana River. The majority of the storm drainage from CCAFS is collected in manmade ditches and canals and is directed westward to the Banana River.

Major inland water bodies in the CCAFS area are the Indian River, Banana River, and Mosquito Lagoon. These water bodies are shallow lagoons, except for the portions maintained as part of the Intracoastal Waterway, between Jacksonville to the north and Miami to the south. The Indian and Banana Rivers join at Port Canaveral and form a combined area of 150,000 acres in Brevard County, with an average depth of 6 ft. This area receives drainage from 540,000 acres of surrounding area.

South of Cape Canaveral, the Indian River is separated from the Atlantic Ocean by a long, narrow island. Island width ranges from a few hundred feet to several thousand feet. Sebastian Inlet to the south provides a direct connection between the Indian River and the Atlantic Ocean. The Indian River is connected to the Atlantic Ocean to the north through Haulover Canal to the Indian River Lagoon and subsequently through Ponce De Leon Inlet.

Ocean currents in the Cape Canaveral area are to the north with an east reversal when winds blow out of the south. The ocean current speed from the Cape Canaveral area to 16 miles offshore is 1 to 3 miles per hour. Beyond 16 miles offshore, the current flows north the majority of the time and is identified as the Florida Current of the Gulf Stream.

Impacts--The proposed activity at Launch Complex 41 will not require any structural alterations that will result in an impact on the surface water hydrology of the area. Deluge water discharged to grade will percolate into the ground and will not result in a significant increase in surface water runoff from Launch Complex 41. No significant impact to the surface water hydrology of the area will occur as a result of the proposed activity at Launch Complex 41.

2.1.6 Water Quality

2.1.6.1 Ground Water--

Ground water in the Floridan Aquifer on CCAFS is highly mineralized (see Table 2.1-6) and is not used as a major domestic or commercial water source (2).

Ground water in the Floridan Aquifer exceeds the national primary and secondary drinking water standards for sodium and total dissolved solids with concentrations of 1,400 mg/L and 1,425 mg/L, respectively.

Ground water in the unconfined aquifer at CCAFS is monitored at the current landfill and Launch Complex 34 (see Figure 2.1-14). The unconfined aquifer is not used as a major water source on CCAFS. Based on annual mean concentrations from 1985 for background wells at these sites (Table 2.1-7), the ground water in the unconfined aquifer at CCAFS is slightly alkaline (mean pH 7.25 to 7.44), with low levels of total organic carbon (1.57 mg/L), low sulfate concentrations (12.69 to 94.55 mg/L), and has low to moderate levels of chloride (12.58 to 802.83 mg/L). Elevated levels of chloride and specific conductivity at Launch Complex 34 are due to the close proximity of this site to the

Table 2.1-6. Water Quality Characteristics of Floridan Aquifer at CCAFS

Parameter	Facility 1717 Well	MCL
Nitrates (as -N)	<0.01	10
Chloride	540	250
Copper	<0.01	1.0
Iron	0.02	0.3
Manganese	<0.001	0.5
Sodium	1,400	160
Sulfate	85	250
Total Dissolved Solids	1,425	500
Color (Pt-Co Color Units)	1	15
pH	7.6	6.5-8.5
Zinc	<0.01	5.0
Arsenic	<0.01	0.05
Barium	0.02	1.0
Cadmium	<0.001	0.01
Chromium	0.001	0.05
Lead	<0.001	0.05
Mercury	0.0005	0.002
Selenium	0.006	0.01
Silvex	<0.001	0.01

All concentrations expressed as mg/L except as indicated.

Sample analysis date: 6/15/84.

MCL = Maximum contaminant levels for National Interim Primary and National Secondary Drinking Water Regulations.

Source: ESE, 1985.

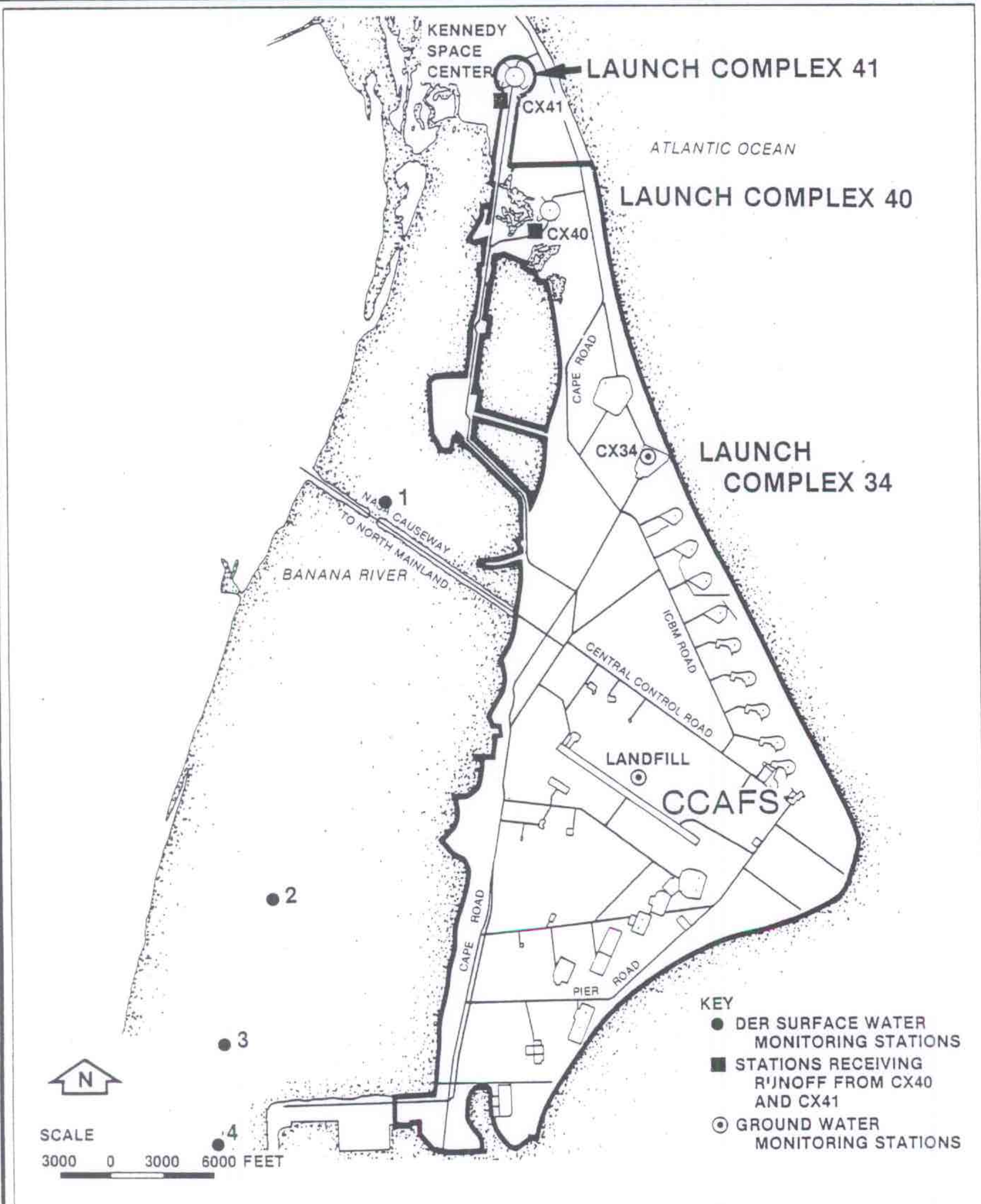

Figure 2.1-14
SURFACE AND GROUND WATER
QUALITY MONITORING LOCATIONS

SOURCE: ESE, 1985.

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Table 2.1-7. Annual Mean Ground Water Data, Unconfined Aquifer CCAFS, 1985*

Parameter	Landfill Well No. 1		Launch Complex 34, North Well		MCL
	Number of Observations	Annual Mean	Number of Observations	Annual Mean	
Bicarbonates	3	205.12		NA	
Calcium	3	72.16		NA	
Chloride	4	12.58	3	802.83	250
Specific Conductance (umhos/cm)	3	413	2	3,295	
Iron	4	0.93	2	1.67	0.3
Potassium	3	1.19		NA	
Magnesium	3	4.05		NA	
Manganese	4	0.02		NA	0.5
Ammonia (as N)	3	<0.1		NA	
Total Organic Nitrogen	3	0.11		NA	
Total Nitrogen	3	0.16		NA	
Nitrate (as N)	2	0.07	3	0.02	10
Sulfate	4	12.69	2	94.55	250
Total Dissolved Solids	3	249.67		NA	500
Zinc	4	0.02	1	1.14	5.0
Total Organic Carbon	3	1.57		NA	
pH (standard units)	2	7.44	3	7.25	6.5-8.5
Arsenic	1	<0.05		NA	0.05
Barium	1	<0.15		NA	1.0
Silver	1	<0.03	2	<0.03	0.05
Cadmium	1	<0.01	2	<0.01	0.01
Chromium	1	<0.04	3	<0.04	0.05
Copper	1	<0.03		NA	1.0
Fluoride	1	0.45		NA	1.4
Mercury	1	<0.0002		NA	0.002
Lead	1	<0.05	3	<0.05	0.05
Selenium	1	<0.01	2	<0.01	0.01

Table 2.1-7. Annual Mean Ground Water Data, Unconfined Aquifer CCAFS, 1985* (Continued, Page 2 of 2)

	Landfill Well No. 1		Launch Complex 34, North Well		
Parameter	Number of Observations	Annual Mean	Number of Observations	Annual Mean	MCL
Sodium	1	8.99		NA	160
Silvex	1	<0.001		NA	0.01
2,4-D	1	<0.01		NA	0.1
Endrin	1	<0.0001		NA	0.0002
Lindane	1	<0.001		NA	0.004
Methoxychlor	1	<0.01		NA	0.1
Toxaphene	1	<0.001		NA	0.005
Hydrocarbons		NA	1	<0.2	
Phenols		NA	3	0.020	

*Unless otherwise noted, all results are in mg/L.

Note: Additional parameters are monitored at the landfill site for priority pollutants, metals, and pesticides as part of the State of Florida regulatory requirements.

MCL = Maximum contaminant levels for National Interim Primary and National Secondary Drinking Water Regulatons.
NA = Not analyzed.

Source: ESE, 1985.

shoreline. Mean iron concentrations range from 0.93 to 1.67 mg/L, whereas concentrations of trace metals and pesticides are generally below analytical detection limits.

Overall, water in the unconfined aquifer at CCAFS is of good quality and meets State of Florida Class G-2 and drinking water quality standards for all parameters analyzed, with the exception of chloride, iron, and total dissolved solids. The elevated concentrations of these parameters are due to the influence of adjacent saline surface waters. Class G-2 ground water is defined by the State of Florida as suitable for "Potable water use, ground water in aquifers which has a total dissolved solids content of less than 10,000 mg/L" (6). No potable water wells are located at Launch Complex 41 or in its vicinity.

Impacts--Potential sources of ground water contamination associated with the reactivation of Launch Complex 41 include:

1. Leaching of heavy metals from paint chips during sandblasting operations.
2. Discharge of nonindustrial sanitary wastes from the onsite package sewage treatment plant (STP).
3. Discharge of deluge water from the flame bucket to ground level within the Launch Complex perimeter.

As part of the reactivation of Launch Complex 41, sandblasting and painting of the MST, UT, Air Conditioning Shelter, and other support facilities will occur. Concerns for sandblasting operations are related to possible contamination of ground and surface waters with paint chips containing high levels of heavy metals. Paint chips from the various structures to be sandblasted have been analyzed for toxicity using the U.S. Environmental Protection Agency (EPA) Extraction Procedure (EP) [40 Code of Federal Regulations (CFR) Part 261--Appendix II]. All paint-chip samples from all structures except one were found to have heavy metal concentrations below the maximum level classified as a toxic substance. The results of paint chip EP toxicity analyses are shown in Table 2.1-8. Paint chips from a vertical post (sample number 2) in the air conditioning shelter had EP toxicity levels of lead of 20 mg/L. This value is four times the maximum EP concentration of 5 mg/L. The plan of work requires that a protective barrier is placed around the vertical post in the air conditioning shelter during sandblasting. Used abrasive and paint chips from this vertical post will be collected and disposed of at an approved hazardous waste disposal site.

To ensure compliance with EPA regulations, prior to disposal of used abrasive and paint residue from the remaining structures, samples of the residuals will be tested using the EP toxicity procedure. If the analysis of the residuals indicates a higher concentration of hazardous metals than the paint chip samples, the used abrasive will be treated as a toxic waste, collected, and disposed of offsite in an appropriate manner. With these safeguards in place, no significant impact to ground or surface waters is expected from the sandblasting operations at Launch Complex 41.

Non-industrial sanitary wastes are treated at Launch Complex 41 by an inplace extended aeration package STP. The STP has a capacity of 13,000 gallons per day (gpd) and is currently operating at less than 1,000 gpd. Effluent is discharged to an underground percolation field adjacent to the STP within the Launch Complex 41 boundary. No major alterations to the STP are anticipated. The STP will provide adequate waste disposal capacity and will not result in a significant impact on the quality of ground water at Launch Complex 41.

During vehicle launch, a large volume of water will be used in the deluge process and subsequent launch complex washdown. Starting approximately 5 seconds before liftoff, approximately 300,000 gallons of deluge water will be released within 10 minutes to suppress acoustic levels and dissipate excess heat from the launch platform area. An additional 100,000 gallons of water will be released for fire suppressant and launch complex washdown and functional checkout.

Table 2.1-8. Results of EP Toxicity Test for Paint Chips from Launch Complex 41
(All results presented as mg/L, analysis conducted using atomic adsorption)

	Sample Locations*															EP Toxicity
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	0.01	0.02	5.0
Barium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	0.1	0.1	100.0
Cadmium	0.6	0.2	<0.2	<0.3	<0.3	0.1	0.2	<0.3	<0.3	<0.03	<0.05	<0.05	<0.05	0.1	0.1	1.0
Chromium	0.6	<0.05	<0.05	<0.5	<1	<0.05	0.8	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	0.2	0.2	5.0
Lead	<0.5	20	<0.5	<1	<0.01	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	0.02	0.05	5.0
Mercury	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0002	0.0005	0.2
Selenium	<0.05	<0.05	<0.05	<0.01	<0.3	<0.05	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.0
Silver	<0.05	<0.05	<0.05	<0.3	<0.05	<0.05	<0.05	<0.3	<0.3	<0.3	<0.05	<0.05	<0.05	0.06	0.06	5.0

*Sample Locations:

1. Air conditioning shed, area between first and second poles, SW end.
2. Air conditioning shed, north side of structure, fourth inner pole from the west end.
3. Air conditioning shed, north addition, first pole on east end.
4. Umbilical Tower—level 12 stairwell.
5. Umbilical Tower—level 4 stairwell.
6. Umbilical Tower—level 2 stairwell.
7. Missile Service Tower—level 12, east side, white paint.
8. Missile Service Tower—ground level, north side.
9. Missile Service Tower—level 3, east side.
10. Missile Service Tower—level 12, east side, red paint.
11. Umbilical Tower—ground level.
12. Umbilical Tower—level 14, stairwell.
13. Umbilical Tower—level 6, stairwell.
14. Missile Service Tower—ground level, northwest side.
15. Missile Service Tower—ground level, southwest side.

Source: Martin Marietta, 1985.

Approximately 30 to 40 percent of this water will be collected in the flame bucket located directly beneath the launch vehicle. Samples of flame bucket water from the initial Titan 34D7 launch will be collected and analyzed for hydrazine, nitrogen tetroxide, pH, state and Federal primary and secondary drinking water standards, specific conductance, and synthetic organic chemicals listed in (9), including purgeables, pesticides, base neutral extractables, and acid extractables. In addition, samples of the flame bucket water from the next launch from Launch Complex 40 will also be analyzed for the above parameters to assess the potential for contamination of flame bucket water. Sampling and analysis of flame bucket water from subsequent Titan 34D7 launches at Launch Complex 41 will be based on the results of the initial flame bucket water analysis. If the flame bucket is found to be contaminated with hydrazine, nitrogen tetroxide, or other hazardous substances, the water will be handled in accordance with applicable Federal and/or state regulations. If the flame bucket water is found to be free from contamination, it will be discharged to grade within the launch complex boundary. Based on observations from Launch Complex 40, the discharged flame bucket water is expected to percolate into the ground and not enter adjacent surface waters. Percolation tests will be conducted in the onsite disposal area at Launch Complex 41 prior to the first launch. Based on data obtained from this test, the discharge flow rate from the flame bucket will be adjusted to ensure that surface flow offsite does not occur. No significant impacts on ground water quality are expected from the disposal of the flame bucket water.

Based on observations of launch activities from Launch Complex 40, approximately 60 to 70 percent of the deluge water and fire suppressant water will run off the launch pad directly to grade. The only potential contaminants used on the launch pad are fuel and oxidizer. Any potential release of these substances would be expected to occur over the flame bucket and would not contaminate launch pad runoff to grade. Any potential accidental or emergency spills or releases of fuel from the Titan 34D7 would be collected and retained in the flame bucket located directly beneath the launch vehicle.

Both the quantity and quality of water running off the launch pad directly to grade will be monitored during the next launch at Launch Complex 40. Runoff water samples will be collected and analyzed for hydrazine, nitrogen tetroxide, pH, Federal and state primary and secondary drinking water parameters, specific conductance, and synthetic organic chemicals listed in Rule 17-22 (9), including purgeables, pesticides, base/neutral extractables, and acid extractables. Due to the absence of potential contamination sources located directly on the launch pad or associated support structures, no significant impacts on ground water quality are expected due to runoff water directly from the launch pad.

2.1.6.2 Surface Water--

Launch Complex 41 is bordered by the Banana River Aquatic Preserve to the west and the Atlantic Ocean to the east. The Banana River is classified by the State of Florida as a Class III water for recreation, propagation, and maintenance of fish and wildlife [Florida Department of Environmental Regulation (4)]. Surface runoff from Launch Complex 41 flows toward the Banana River.

Surface water quality data are available from sites receiving runoff from Launch Complexes 40 and 41 (see Figure 2.1-14). The sampling location associated with Launch Complex 40 is located in a marsh area south of Launch Complex 40; the sampling location associated with Launch Complex 41 is located in a drainage canal south of Launch Complex 41. Mean water quality conditions from the quarterly monitoring program from 1983 through 1985 for these two locations are presented in Table 2.1-9. Water quality associated with both Launch Complex 40 and Launch Complex 41 were similar with the exception of higher chloride, total dissolved solids, and specific conductance values at Launch Complex 40. These parameters reflect the predominately estuarine conditions present

Table 2.1-9. Mean Surface Water Quality Associated with Launch Complexes 40 and 41 from Quarterly Monitoring Program 1983 Through 1985*

Parameter	Launch Complex 40		Launch Complex 41		Class II Standards†
	Number of Observations	Annual Mean	Number of Observations	Annual Mean	
Chloride	2	7,475	1	85.1	
Dissolved Oxygen	2	5.9	1	7.2	5.0
Biochemical Oxygen Demand	2	8.5	1	7	
Total Dissolved Solids	2	15,310	1	435	
pH (standard units)	9	8.08	4	7.7	6.5-8.5
Specific Conductance (umhos/cm)	5	12,082	2	2,965	
Turbidity (NTU)	2	8.93	1	1.00	29
Detergents	2	<0.09	1	<0.08	0.5
Hydrocarbons	11	0.67	6	0.46	
Phenols	12	0.133	7	0.051	0.001
Cyanide	2	<0.005	1	<0.005	0.005
Fluoride	2	0.64	1	0.45	5.0
Arsenic	2	0.003	1	0.003	0.05
Chromium	11	<0.04	7	<0.03	0.005
Iron	12	0.078	9	3.40	0.3
Mercury	2	<0.001	1	<0.001	0.0001
Lead	12	0.072	7	<0.05	0.05
Zinc	2	0.02	1	0.01	1.0
Copper	12	<0.03	7	<0.03	0.015
Cadmium	12	<0.01	7	<0.01	0.005

*Unless otherwise noted, all results in mg/L.
†Based on criteria for predominantly marine waters 17-3 FAC.

Note: This table contains all available data for Launch Complex 40 and Launch Complex 41. Not all parameters were sampled during all sampling events.

Source: ESE, 1985.

at the Launch Complex 40 sampling location and the increased influence of freshwater runoff at the Station 41 sampling site. Dissolved oxygen, biochemical oxygen demand, pH, and turbidity at both locations were representative of good water quality. Mean arsenic and trace metal concentrations (with the exception of iron which had a mean concentration of 3.4 mg/L at Launch Complex 41) were low or below analytical detection limits at both locations. Overall, good surface water quality is associated with both Launch Complexes 40 and 41.

FDER maintains a network of water quality monitoring stations along the Banana River. The four monitoring stations closest to Launch Complex 41 are located between NASA Causeway and State Road 528 (see Figure 2.1-14). The closest station is located just north of NASA Causeway at a distance of approximately 2,600 ft from Launch Complex 41. A summary of available water quality data at these stations is presented in Table 2.1-10.

The Banana River is an estuarine environment with mean salinity values in the Cape Canaveral area ranging from 17.75 ppt at Station 1 near NASA Parkway to 23.82 ppt at Station 4 at State Road 258. Mean dissolved oxygen at all stations was greater than 5.5 mg/L and biochemical oxygen demand less than 2.5 mg/L. Nutrients (nitrogen and phosphorus) were representative of estuarine conditions, as were chlorophyll-a concentrations and turbidity. Metals data are available only from Station 4 at State Road 528. Metals at this station are low and representative of good water quality conditions. Overall, the Banana River adjacent to CCAFS is characterized as having good water quality.

Impacts--Potential sources of surface water contamination associated with the reactivation of Launch Complex 41 and subsequent Titan launch program include:

1. Normal flight, which results in the impact of spent, suborbital stages (containing some residual propellants) and jettisoned hardware into the ocean.

Table 2.1-10. Mean Surface Water Quality in Banana River Adjacent to CCAFS*

Parameter	Station 1		Station 2		Station 3		Station 4	
	Number of Observations	Mean	Number of Observations	Mean	Number of Observations	Mean	Number of Observations	Mean
Secchi Depth (meters)	2	1.2	2	1.1	2	1.05	76	1.2
Color (Pt-Co Color units)	2	12.5	2	10.0	2	12.5	133	12.7
Specific Conductance (umhos/cm)	2	28,700	2	30,400	2	29,250	23	34,367
Dissolved Oxygen	2	5.6	2	6.1	2	5.95	33	6.55
Biochemical Oxygen Demand	2	2.3	2	1.45	2	1.85	71	2.08
pH	2	8.45	2	8.5	2	8.45	96	8.22
Total Alkalinity (as $CaCO_3$)	2	164.0	2	164.5	2	160.5	117	141.3
Salinity (ppt)	2	17.75	2	19.0	2	19.25	35	23.82
Total Kjedahl Nitrogen (as N)	2	1.55	2	1.23	2	1.35	54	1.39
$NO_3 + NO_2$ (as N)	2	0.01	2	0.01	1	0.01	52	0.09
Total Phosphorus (as P)	2	0.04	2	0.03	2	0.05	114	0.11
Chlorophyll a (ug/L)	2	2.65	2	4.12	2	6.93	18	8.04
Turbidity (NTU)	2	6.60	2	6.25	2	7.95	16	5.11
Total Organic Carbon		NA		NA		NA	74	15.92
Calcium		NA		NA		NA	4	54.20
Sodium		NA		NA		NA	2	4,759
Potassium		NA		NA		NA	2	161.45
Fluoride (total)		NA		NA		NA	1	0.61
Cadmium (total)		NA		NA		NA	14	0.003
Chromium (total)		NA		NA		NA	8	0.083
Copper (total)		NA		NA		NA	17	0.044
Iron (total)		NA		NA		NA	52	0.205
Lead (total)		NA		NA		NA	37	0.023
Manganese		NA		NA		NA	1	12.0
Mercury (total)		NA		NA		NA	9	0.0002

*Unless otherwise noted, all values are expressed in mg/L.

ppt = Parts per thousand.
NA = not analyzed.

Source: ESE, 1985; FDER, 1986.

2. In-flight failures which may result in vehicle hardware and propellants falling into the ocean or nearby surface waters.
3. On-pad accidents and propellant spills which may result in run-off of propellants to local drainage systems.
4. Contamination of surface waters from exhaust cloud deposition of HCl and Al_2O_3.

Under normal flight conditions, vehicle stages which do not go into orbit have trajectories which result in ocean impact. Stages that reach initial orbit will re-enter the atmosphere as a result of orbital decay, and may enter the water. Re-entry trajectories for various spent stages are slightly different depending on whether the Centaur or IUS upper stage is used. Re-entry trajectories for the spent SRMs are programmed to impact approximately 200 miles from U.S. coastal areas for flights utilizing either a Centaur or IUS upper stage. Re-entry trajectories for spent Stage I, (for Centaur missions, Stage II) are programmed to impact 900 miles downrange. Stage II of IUS missions will remain in orbit, while Stage II of Centaur missions will be programmed to impact 2,700 miles downrange.

Corrosion of stage hardware will contribute various metal ions to the water column. Due to the slow rate of corrosion in the marine environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur.

Relatively small amounts of propellant may also be released into the ocean along with the various spent stages. SRMs may contain small quantities of ammonium perchlorate mixed in a rubbery binder. Release to the water column will be slow, with toxic concentrations occurring only within a few feet of the propellant, if they occur at all. Both Aerozine 50 and nitrogen tetroxide are soluble in water and may be present in small quantities in spent liquid fuel stages. A residual of Aerozine 50/nitrogen tetroxide may enter the ocean as the result of normal flight. For IUS missions, the Stage I residual propellant amounts to approximately 1,100 pounds. For Centaur missions, the Stage I and II residual propellants amount to approximately 1,250 pounds. Concentrations in excess of the maximum acceptable concentration of these compounds for marine organisms will be limited to the immediate vicinity of the spent stage. Due to the limited number of launch events scheduled, the small amount of residual propellants present, and the large volume of water available for dilution, no significant impacts are expected to be caused by the re-entry of spent stages.

The possibility exists of an inflight termination and the activation of the vehicle destruct system. Under such conditions, the liquid propellant tanks are ruptured and the propellants dispersed. Due to the hypergolic (igniting upon contact without external aid) nature of Aerozine 50 and nitrogen tetroxide, the propellants likely will ignite and burn. The completeness of this burn is not known, and the possibility of some liquid propellant entering the water must be considered. Under most conditions, given the availability of the emergency destruct system which has never failed, the amount of unburnt propellant reaching surface waters will be significantly less than the entire liquid fuel load. In addition, the amount of liquid propellant released will depend on the time of flight.

As a worst-case situation, it is possible that the vehicle may be terminated only a few seconds after lift-off and will result in the entire quantity of liquid propellant being released into the ocean or nearby surface waters. In the event of a near-shore or near-pad impact of a vehicle following termination, water quality may be significantly impacted. The area in which the maximum acceptable concentration of Aerozine 50 and nitrogen tetroxide will be exceeded will depend on the amount of propellant released and the depth of the water column. Based on a dispersion model used in the Final Environmental Statement for the United States Air Force Space Launch Vehicle (31), the radius of the contaminated area could vary from approximately 800 to 8,000 ft, depending on the quantity of the propellant entering the ocean or nearby surface waters.

In assessing the overall significance of such a worst-case release, the likelihood of such an event must be considered. Because of the established reliability of the Titan 34D vehicle, the probability of an early flight abortion (prior to ignition of liquid stage 1 which occurs approximately 115 seconds into flight) appears to be less than 2×10^{-4} (31). For this worst-case situation to occur, an early-flight failure of the Titan 34D7 vehicle and failure of the vehicle destruct system (never observed) would have to occur. It is highly unlikely that these events simultaneously will occur.

On-pad accidental or emergency releases of small quantities of propellants may occur as a result of the Titan 34D7 program at Launch Complex 41. All propellant spills will be retained in the impervious holding areas surrounding the fuel supply tanks or in the flame bucket located immediately beneath the launch vehicle. Spilled propellants will be removed from these areas and disposed of at an appropriate hazardous waste facility offsite. On-pad spills of propellants will not significantly impact surface water quality around Launch Complex 41.

The final surface water quality consideration is the potential interaction between the exhaust cloud produced by the Titan 34D7 launch vehicle and adjacent surface waters.

The primary products of combustion by weight from the Titan 34D7 SRMs are HCl (21 percent), CO (28 percent), and Al_2O_3 (30 percent). The impact of the exhaust cloud on surface water quality will be a function of the composition of the exhaust cloud, duration of contact with the water, wind speed and direction, and other atmospheric conditions. To date, no studies have been conducted on the direct effects of Titan launch activities on adjacent surface waters. However, an evaluation of potential impacts can be based on atmospheric studies of exhaust cloud dynamics and its constituents. Furthermore, a number of studies have been conducted assessing the effects of Space Shuttle launches on surface water quality (3, 25, 22). Although significant differences exist between the Titan 34D7 vehicle and the Space Shuttle, both vehicles use solid propellant that produces an exhaust cloud.

The four significant differences between the Space Shuttle and the Titan 34D7 are:

1. Overall quantity of propellants,
2. Volume of water vapor produced during launch,
3. Type of engines used during initial liftoff, and
4. Thrust-to-weight ratio.

The Titan 34D7 uses approximately 60 percent less solid propellant than the Space Shuttle. Consequently, the Titan 34D7 produces a proportionately smaller exhaust cloud containing approximately 60 percent less HCl than the exhaust cloud produced by the Space Shuttle.

Second, the volume of water vapor produced during launch of the Titan 34D7 which is available for mixing with the other exhaust products in the ground cloud is significantly smaller. Large quantities of water vapor produced by the Space Shuttle by the vaporization of deluge water and the formation of water vapor by the reaction of liquid oxygen and liquid hydrogen in the main engines. Both the Space Shuttle and the Titan 34D7 use similar quantities of deluge water during lift-off. However, the proportion of the deluge water vaporized exhaust heat is greater for the Space Shuttle, due to its slower ascent from the launch pad as a result of its lower thrust-to-weight ratio. Vaporized deluge water, in conjunction with water vapor produced by the Space Shuttle main engines results in more water vapor in the shuttle ground cloud than in the Titan cloud. Both water and water vapor scrubs HCl out of the exhaust cloud in the form of liquid HCl. Since the exhaust cloud produced by the Titan vehicle is drier (less water vapor), more of the HCl will stay in a gaseous form and will not be deposited directly in adjacent surface waters.

The third significant difference between the Space Shuttle and the Titan 34D7 is the type of engines used during initial lift-off. Lift-off of the Titan 34D7 vehicle will be accomplished through the use of two SRMs (stage zero). The liquid propellant stages do not ignite until approximately 115 seconds after lift-off (ignites at stage 1); therefore, the exhaust products from the Titan 34D7 liquid stages are not associated with development of the ground cloud. On the other hand, lift-off of the Space Shuttle is accomplished by the more or less simultaneous ignition of two SRBs and three liquid hydrogen and liquid oxygen main engines. One of the primary exhaust products produced during liftoff of the Space Shuttle is water vapor formed by the reaction of liquid hydrogen with liquid oxygen. The water vapor from the Space Shuttle's main engines and vaporized deluge water combines with the HCl from the Space Shuttle's SRBs to form a highly acidic mist.

In the case of the Titan 34D7, only minimal amounts of vaporized deluge water will be produced; therefore, the HCl in the ground exhaust cloud produced by the Titan 34D7 will be in a gaseous form and will not be deposited as rapidly under most atmospheric conditions. Thus, the rate of deposition of HCl from the Titan 34D7 vehicle will be lower than that observed for the Space Shuttle.

Finally, the thrust-to-weight ratio of the Titan 34D7 vehicle is significantly higher than that for the Space Shuttle. Thus, the Titan 34D7 vehicle will accelerate quicker and clear the launch pad in less time, producing a small ground level exhaust cloud with less potential for environmental effects.

The primary concern associated with the exhaust cloud impacts on water quality is the formation of large quantities of HCl. Stage zero of the Titan 34D7 vehicle will carry 1.184 x 10^6 pounds of propellant (UTP-3001B) (13). The propellant is polybutadiene-acrylic-acid-acrylonitrile-based and contains 84-percent solids (16 percent aluminum and 68 percent ammonium perchlorate, plus additives, and an iron oxide catalyst) (13). Stage zero will fire for approximately 2 minutes and will generate the majority of the ground level exhaust cloud. Due to the rapid ascent of the Titan 34D7 off the launch pad, only the exhaust from the first few seconds of the SRM burn will be in the ground cloud. The ground cloud will likely exist from several minutes to several hours. The cloud will move downwind of the launch complex, and will be over any single location only for a period of several minutes prior to dispersal. A significant portion of the exhaust generated may drift toward the Banana River or the Atlantic Ocean, depending on wind direction. Short-term acidification of surface water may result from direct contact with the exhaust cloud and through deposition of HCl in the form of dryfall. Deposition of HCl in wet precipitation will be a function of ambient weather conditions. Incidences of local washout of HCl are expected to occur only under rainfall conditions. Launch constraints do not allow liftoff during rain or storm conditions. Due to atmospheric diffusion of the exhaust cloud, impacts to surface waters will likely be restricted to the area adjacent to Launch Complex 41. As a result of the extensive bicarbonate buffering capacity of ocean water, no significant impact due to HCl deposition will occur in waters east of Launch Complex 41. Under certain atmospheric conditions, portions of the Banana River and adjacent marshes could potentially experience a short-term increase in acidity due to HCL deposition.

Dreschel and Hall (3) conducted a study of near-field deposition patterns of chloride from launches of the Space Shuttle at KSC. Near-field effects of HCl deposition generally were restricted to a distance of approximately 930 ft from the perimeter of Launch Complex 39A.

Launch Complex 41 is located approximately 700 ft from the edge of the marsh area to the west and approximately 3,000 ft from open water in the Banana River. Based on the areal extent (930 ft) of the nearfield impact from the Space Shuttle exhaust cloud, and because the ground cloud from the Titan 34D7 is smaller and contains 60 percent less HCl than the Space Shuttle, the likely maximum area of impact associated with Launch Complex 41 will extend only to the near area of the marsh. Within this area, only minor short-term decrease in pH may occur because the HCl in the Titan 34D7 ground cloud will be in a gaseous form and will not result in significant HCl deposition.

Any decrease in pH in this region will be of short duration and will be rapidly neutralized by the bicarbonate buffering system within the Banana River. Due to the smaller volume of propellant used by the Titan 34D7 vehicle and the proportionately smaller exhaust cloud generated due to the greater thrust-to-weight ratio, it is likely that the area of near-field impacts will be significantly smaller than those observed for the Space Shuttle.

Al_2O_3 also will be present in relatively large quantities in the exhaust cloud from the Titan 34D7 vehicle SRMs. No studies of Al_2O_3 deposition to surface waters have been conducted for the Titan vehicle. However, studies of Al_2O_3 deposition on terrestrial vegetation have been conducted for the Space Shuttle program. In a study (25), Al_2O_3 was found on plant leaves up to 22 km from the launch pad. Aluminum deposition was found to vary from 0.6 to 107 micrograms of aluminum per square meter (ug-Al/m^2) within the 22 km area of far-field effects. The distribution of Al_2O_3 deposition within the far-field area was found to be dependent upon various atmospheric conditions such as wind speed and direction and precipitation. Al_2O_3 deposition was found to be highly variable at the various sampling locations on both a spatial and temporal basis. This was primarily due to variations in the movement and diffusion of the exhaust clouds due to change in wind speed and direction.

Deposition of Al_2O_3 in surface waters will also depend on wind direction and speed. It is possible that Al_2O_3 could be deposited in the coastal marsh and the Banana River as a result of easterly winds during vehicle launch. Deposition of Al_2O_3 in surface waters and marshes will be limited by diffusion of the exhaust cloud in the atmosphere and the distance from Launch Complex 41 to the Banana River (3,000 ft). Tidal flushing in the marsh areas will prevent accumulation of significant quantities of Al_2O_3. Due to the smaller volume of propellant used by the Titan 34D7 vehicle (60 percent less than the Space Shuttle), the total production of Al_2O_3 and overall deposition of Al_2O_3 will be significantly smaller than observed for the Space Shuttle.

Deposition of HCl and Al_2O_3 from the Titan 34D7 vehicle exhaust cloud will not significantly impact surface water quality around Launch Complex 41.

2.1.7 Biota

CCAFS is located in east-central Florida on the Cape Canaveral Peninsula. Ecological resources on the station are influenced by the Atlantic Ocean on the east and the Banana River on the west. Vegetation communities and related wildlife habitats are representative of barrier island resources of the region. Major communities at CCAFS include beach, coastal strand and dunes, coastal scrub, lagoons, brackish marsh, and freshwater systems in the form of canals and borrow pits.

In addition to communities found at CCAFS, coastal hammocks and pine flatwoods are found on KSC to the northwest and increase the ecological diversity and richness of the area.

The restrictive nature of CCAFS and KSC activities has allowed large areas of land to remain relatively undisturbed. Of 15,438 acres on CCAFS, 11,977 acres has remained or reverted back to natural conditions.

2.1.7.1 Terrestrial Biota--

Coastal scrub is the largest natural community at CCAFS, covering approximately 9,400 acres. The coastal scrub association is characterized by xeric tree species including scrub oak (Quercus chapmanir), live oak and sand live oak (Q. virginiana), and myrtle oak (Q. myrtifolia). The scrub community is a harsh environment limited by low soil moisture conditions. Herbaceous and shrub vegetation is sparse and includes wire grass (Aristida sp.), saw palmetto (Serenoa repens), tar flower (Befaria racemosa), lantana (Lantana sp.), wax myrtle (Myrica cerifera), greenbriar (Smilax sp.), prickly pear (Opuntia spp.), gopher apple (Asimina obovata), and others. Wildlife species that occur in coastal scrub habitat are listed in Appendix C.

Coastal strand and dune communities are also harsh environments. Plants and animals that inhabit these communities must adapt to extremes in temperatures and prolonged periods of drought. The strand occurs between the coastal scrub community and the salt spray zone of the dune system. Growth characteristics of strand vegetation produces a low profile that is maintained by nearly constant winds. Plants that can tolerate strand conditions are saw palmetto, wax myrtle, tough buckthorn (Bumelia tenax), cabbage palm (Sabal palmetto), partridge pea (Cassia fasciculata), prickly pear, and various grasses.

The dune community is a narrow strip of land between the beach and strand systems. Dunes are sparsely vegetated due to constant winds and salt spray. The few species that survive on dunes are important because they provide the only stabilizing force in erosion control. Representative wildlife species that commonly inhabit dunes and coastal strand are listed in Appendix C.

Beaches of KSC and CCAFS are nonvegetated but provide significant wildlife resources. The tidal zone supports a high number of marine invertebrates, as well as small fish that are food for many shore birds. Several species of gulls, terns, sandpipers, and others use beaches of the Cape Canaveral area. In addition, research indicates that the beaches at CCAFS and KSC are very important to nesting sea turtles. The most common turtle nesting on CCAFS is the loggerhead sea turtle (Caretta caretta) and also important, but to a lesser degree, the Atlantic green turtle (Chelonia mydas). Careful management is ongoing to protect this important marine turtle breeding resource.

Pine flatwoods occurring at KSC are similar in composition to those found along the east coast. Dominant tree species are pines, including slash pine (Pinus elliotii), longleaf (P. palustris), and sand pine (P. clausa). Understories are dominated by saw palmetto and include tar flower, fetterbush (Lyonia ferruginia), wax myrtle, and wire grass. Some flatwood areas have succeeded into scrub communities, especially along sand ridges. Wildlife species common to flatwoods include rufous-sided towhee (Pipilo erythophthalmus), eastern meadowlark (Sturnella magna), mockingbird (Mimus polyglottos), Bachman's sparrow (Aimophila aestivalis), nine-banded armadillo (Dasypus novemcinctus), and gopher tortoise (Gopherus polyphemus).

Coastal hammocks are characterized by closed canopies provided by cabbage palms, which is the dominant tree species. The hammock, being shaded from intense insolation, retains higher levels of soil moisture. Additional tree species in hammocks are red bay (Persea borbonia), live oak, and strangler fig (Ficus aurea). Vegetation found in shrub and ground layers are saw palmetto, greenbriar, grape (Vitis rotundifolia), virginia creeper (Parthenocissus quinquefolia), shoestring fern (Vittaria lineata), and Boston fern (Nephrolepis cordifolia). Wildlife that inhabit coastal hammocks are listed in Appendix C.

Wetlands within and surrounding CCAFS and KSC facilities are important wildlife resources. Wetland types that are found in the area include freshwater ponds and canals, brackish impoundments, tidal lagoons, bays, rivers, vegetated marshes, and mangrove swamps. These wetlands provide resources for a vast assemblage of marine organisms, waterfowl, and terrestrial wildlife. Management of wetland resources includes controlling water levels in impoundments, stocking of fish in freshwater bodies, and legally protecting many wildlife species and the wetland habitat itself. Species known to occur in wetland habitats are listed in Appendix C.

Impacts--The reactivation of Launch Complex 41 is not expected to significantly impact terrestrial and wetland biota on CCAFS. All proposed activities will be conducted within the existing launch complex boundary and will not result in the loss of any additional habitat. Increased personnel activity and elevated noise levels associated with the refurbishment of Launch Complex 41 may result in a temporary disturbance to wildlife in the immediate vicinity. This disturbance will be of short duration and will not have significant long-term impacts.

No wading bird nesting colonies are known to exist in the immediate vicinity of Launch Complex 41. Elevated noise levels associated will launch events will be limited in occurrence and will not significantly affect wildlife populations on CCAFS.

Local wildlife will not be exposed to hazardous or toxic chemicals as a result of activities at Launch Complex 41. Containment provisions at the launch site will prevent spilled propellants or contaminated water from being released to the surrounding environment. Wildlife in the direct path of the ground level exhaust cloud may experience short-term elevated levels of nuisance dust, primarily Al_2O_3, and elevated levels of HCl. Based on studies of Titan IIIC launches at CCAFS, HCl has not been detected within the ground cloud in toxic concentrations (31). Due to the infrequency of launches at Launch Complex 41, Al_2O_3 from Titan 34D7 launches will be far below the Primary National Ambient Air Quality Standard (31). In addition to these considerations, the exhaust cloud will be subject to the prevailing winds and will remain over any single point a relatively short period of time. Overall, no significant impact to wildlife on CCAFS will result due to the ground level exhaust cloud.

2.1.7.2 Aquatic Biota--

In terms of aquatic biota, the Cape Canaveral region is a transition zone between temperate and subtropical forms. The northern Indian River lagoon system is a shallow system with limited ocean access, limited tidal flux, and generally mesohaline salinities. Because of the shallowness of the system, the aquatic environment is subject to wide fluctuations in temperature and salinity. Further, the system has a limited number of habitat types. As such, the northern Indian River lagoon presents a relatively harsh environment for the aquatic fauna inhabiting the area. The diversity of fishes and benthic macroinvertebrates is relatively low as compared with the southern portions of the lagoon system. The aquatic organisms which do inhabit this area are generally adapted to the fluctuating conditions of the local aquatic systems.

Seagrasses, when present, are important components of the aquatic environment. Important functions of seagrass beds are organic production; sediment stabilization; and habitat, feeding, and nursery areas for various organisms.

Seagrasses are present in the northern Indian River system. Species of seagrass reported from the project area are _Halodule wrightii_ (Cuban shoal grass), _Cymodocea filiformis_ (manatee grass), _Thalassia testudinum_ (turtle grass), and _Halophila engelmannii_ (1, 15, 24, 30). The most abundant of these are _H. wrightii_ and _C. filiformis_. The seagrasses are generally found as patches in shoal areas less than 1 m deep and are surrounded by open sandy areas. Environmental factors affecting their distribution are the seasonal accumulation and shifting of sediments, water temperature, water depth, salinity, epiphyte coverage, and water clarity. The period of greatest vegetative growth of the seagrasses occurs from spring to early summer, when water temperatures are moderate and wind-induced shifting and resuspension of sediments are minimal.

The importance of seagrasses as habitat in the Indian and Banana Rivers was determined by 1, 15, 33, who found greater diversity of fishes and invertebrates associated with seagrass beds.

Benthic macroinvertebrates of the northern Indian and Banana Rivers can be classified as estuarine-marine animals. The benthos is dominated by polychaetes (marine worms), molluscs, and crustaceans. Listed in (23) are 122 species of benthic macroinvertebrates from brackish lagoons surrounding Launch Complex 39A and the northern Banana River. Sixty-seven species were discovered in the lagoons; 108 species were discovered in the Banana River. The two habitats had 53 species in common. Thomas (30) discovered 75 taxa of benthos in the northern Indian River. ABI (1) and infaunal benthos collected horseshoe collected horseshoe crabs, blue crabs, and penaid shrimp. Although ABI (1) collected shrimp species of commercial importance, the northern Indian River was not an important nursery area for these species. Mosquito Lagoon, north of the project area, was considered an important shrimp nursery area. Blue crabs were determined to spawn in the area.

The fish of the northern Indian River system were studied by 26, 27, and 15. Snelson (26) and Snelson (26) collected 139 species, and Mulligan and Snelson (15) collected 57 species (see Appendix C) from eight permanent sampling stations. According to these authors, fish diversity in the northern Indian River system, when compared to the southern part of the system, is low. The primary reasons for the low fish diversity were considered to be latitude and climate, lack of diverse habitats, and limited ocean access.

Little natural fresh water exists in the northern Indian River lagoon; therefore, few freshwater fish inhabit the area. Freshwater fishes which do occur, primarily on Merritt Island, occur in disturbed habitat. These are generally silversides, killifishes, and livebearers, and introduced antrarchids and golden shiner. These fish are hardy and adapted to and characteristic of harsh environments.

The numbers of fish were greater in the Indian River (15), but the diversity of fish was greater in the Banana River. Vegetative cover and salinity appeared to be important factors governing this distribution. The fish community was dominated by only a few species; 15 species comprised 99.5 percent of all fish and Anchoa mitchelli (bay anchovy) comprised 87.5 percent of all fish. A similar situation for the fish community was found in the Indian River (1).

Impacts--The reactivation of Launch Complex 41 will not have a significant long-term negative impact on aquatic biota. No additional discharges directly to surface waters around Launch Complex 41 will result from the proposed activities. Spill containment areas within the launch complex boundary will prevent the release of spilled propellants to surface waters. No dredge and fill activities will be conducted as part of the proposed activity.

The potential exists for an early inflight termination and the activation of the vehicle destruct system. Due to the hypergolic nature of Aerozine 50 and nitrogen tetroxide, the majority of the propellants will ignite and burn. Since the completeness of this burn is not known, the possibility of some liquid propellant entering the water must be considered. A worst-case failure would involve not only a near-pad failure of the Titan vehicle, but also the simultaneous failure of the vehicle destruct system, which has never been observed. Under such worst-case conditions, water quality and aquatic biota may be locally impacted for a short period of time with the degree of impact dependent on the amount of propellant released and the depth of the water column. Based on a dispersion model used in the Final Environmental Statement for the United States Air Force Space Launch Vehicle (31), the radius of the contaminated area could vary from approximately 800 to 8,000 ft, depending on the fraction of the propellant entering the ocean.

Because of the established reliability of the Titan IIID vehicle, the probability of an early flight abortion (prior to ignition of liquid stage 1) appears to be less than 2 x 10^{-4} (31). For this worst-case situation to occur, an early-flight failure of the Titan 34D7 vehicle and failure of the vehicle destruct system (never observed) would need to take place. In the unlikely event of a worst-case flight failure and failure of the vehicle destruct system, localized short-term impacts to fish and other aquatic organics could occur.

The final potential impact on aquatic biota is the interaction of the ground level exhaust cloud with surface water. The primary products of combustion by weight from the Titan 34D7 SRMs are HCl (21 percent), CO (28 percent), and Al_2O_3 (30 percent). The impact of the exhaust cloud on aquatic biota will be a function of the composition of the exhaust cloud, duration of contact with the water, wind speed and direction, and other atmospheric conditions.

Launch constraints do not allow for Titan launches during rain or heavy cloud cover. As a result, the potential for HCl washout due to such factors is insignificant. A potential impact on aquatic biota can be expected if a rain event occurs offsite simultaneously with the passage of an exhaust cloud over the Banana River. Under such conditions, washout of HCl from the ground cloud could produce precipitation with a pH <1.5 to a distance of 4 km downwind from the launch complex. The passage of a rainstorm across an exhaust cloud may occur only on an infrequent basis since launch constraints do not allow for launch during rain events or during periods of heavy cloud cover; therefore, this HCl washout is not expected. In the event of such an occurrence, the overall impact of this acidified precipitation on aquatic biota is expected to be insignificant because the ground cloud and resultant acidic precipitation will be over any single point for a short period of time. In addition, the relatively high buffering capacity of the Banana River (mean alkalinity = 160 mg/L) will neutralize the excess acidity in a relatively short time period.

Deposition of Al_2O_3 from the exhaust cloud may occur over surface waters, depending on wind speed and direction during vehicle launch. Due to the low number of planned launch events and relatively rapid dispersion of the exhaust cloud, deposition of large quantities of Al_2O_3 is not expected to occur in adjacent surface waters. Any additional Al_2O_3 entering the aquatic environment as a result of Titan 34D7 launch activities will likely remain insoluble at the ambient pH of the Banana River (8.0-8.5). Aluminum will be nontoxic to most aquatic organisms at the pH range in the Banana River; localized fish kills in the Banana River are not expected to occur as a result of the CELV Program due to the distance of the launch complex from the Banana River and the relatively small exhaust cloud produced by the Titan 34D7 as compared to the Space Shuttle.

Overall, no significant long-term adverse impacts to aquatic biota are expected to occur as a result of the ground level exhaust cloud from activities at Launch Complex 41.

2.1.7.3 Endangered and Threatened Species--

The U.S. Fish and Wildlife Service (USFWS) and Florida Game and Fresh Water Fish Commission (FGFWFC) protect a number of wildlife species listed as endangered or threatened under the Federal Endangered Species Act of 1973 (as amended), and under the Florida Endangered and Threatened Species Act of 1977 (as amended), respectively. The presence, or potential for occurrence, of such species on CCAFS was determined from consultations with USFWS, FGFWFC, and CCAFS and KSC environmental staff, and from a literature survey.

Seven species listed as endangered, and three species listed as threatened by USFWS are known to reside or seasonally occur on CCAFS. FGFWFC lists two additional species as threatened, but USFWS does not list these species as threatened. Endangered and threatened species residing or seasonally occuring on CCAFS and adjoining waters are listed in Table 2.1-11.

A review of CCAFS endangered or threatened species shows that only three species (southeastern Kestrel, Florida scrub jay, eastern indigo snake) potentially occur in the immediate vicinity of Launch Complex 41 based on an analysis of available coastal scrub habitat surrounding the site. An additional three species (woodstork, baldeagle, peregrine falcon) may occasionally occur in wetlands located to the east of the complex. Caribbean manatees, green turtles, ridley turtles, and loggerhead turtles are known to occur in the Banana River, Mosquito Lagoon and along Atlantic Ocean beaches. The remaining two species, dusky seaside sparrow and red-cockaded woodpecker, are not expected to occur in the vicinity of Launch Complex 41 due to the absence of suitable habitat. Dusky seaside sparrows, in fact, are extirpated from the northern CCAFS area (35). The habitats of endangered and threatened species on CCAFS are protected and managed by the CCAFS Fish and Wildlife Management Plan (20). A major objective of this plan, which establishes procedures for the conservation and preservation of all species of fish and wildlife inhabiting CCAFS, is the protection of endangered and threatened species and their habitats. In addition, the impacts of USAF activities, as well as NASA activities at nearby KSC, on such species are carefully monitored by CCAFS and KSC environmental staff (c.f.: 32, 16, 18).

Impacts--Any USAF action that may affect federally listed species on their critical habitats requires consultation with USFWS under Section 7 of the Endangered Species Act. As such, USAF has officially notified USFWS of the proposed renovations and modifications to Launch Complex-41, and of the subsequent CELV program. A copy of this letter

Table 2.1-11. Endangered and Threatened Species Residing or Seasonally Occurring on CCAFS and Adjoining Waters

Species	Status USFWS*	Status FGFWFC†
Mammals		
Caribbean manatee (Trichechus manatus)	E**	E
Birds		
Wood stork (Mycteria american)	E	E
Bald eagle (Haliaeetus leucocephalus)	E	T††
Peregrin falcon (Falco peregrinus)	T	E
Southeastern kestrel (Falco sparverius)	-	T
Red-cockaded woodpecker (Picoides borealis)	E	T
Florida scrub jay (Aphelocoma coerulesens)	-	T
Dusky seaside sparrow (Ammospiza maritima)	E	E
Reptiles		
Atlantic green turtle (Chelonia mydas)	E	E
Atlantic ridley turtle (Lepidochelys kempi)	E	E
Atlantic loggerhead turtle (Caretta caretta)	T	T
Eastern indigo snake (Drymarchon corais)	T	T

*U.S. Fish and Wildlife Service.
†Game and Fresh Water Fish Commission.
**E = Endangered.
††T = Threatened.

Source: ESE, 1985.

is attached in Appendix B. In addition, USAF is currently preparing a Biological Assessment designed to assess the potential impacts of the CELV program and associated Launch Complex 41 renovations or endangered and threatened species. This Biological Assessment, along with a "no jeopardy" opinion, will be submitted to USFWS.

No adverse impacts are anticipated on endangered or threatened species residing on CCAFS and adjoining waters from the CELV program or Launch Complex 41 modifications. This finding is based on an analysis of occurrence and habitat requirements of endanged and threatened species such as southeastern kestrel, Florida scrub jay, and eastern indigo snake potentially occurring in scrub habitats surrounding Launch Complex 41. All modifications to the launch complex will occur within its fenced, cleared areas, and will not result in the destruction or modification of wildlife habitat. High noise levels from Titan 34D7 launches will occur only twice a year and are temporary. With the exception of occasional small brush fires in the vicinity of the launch complex, no significant destruction or permanent adverse impacts on the surrounding scrub habitat is expected to occur from launch operations. The Air Force, as well as the staff of the nearby Merritt Island National Wildlife Refuge, has standby fire fighting equipment preparation to control such fires.

A letter from USFWS in resonse to USAF modifications or consultation states that if the work is confined to the existing disturbed site, there should not be a problem with the project insofar as endangered species are concerned: (35). A copy of this letter is shown in Appendix B.

No adverse impacts from CELV activities are expected on other endangered or threatened species occuring on other portions of CCAFS, or in adjoining waters. The proposed CELV program is compatible with the present, surrounding land use. Specific activities of the CELV program, and their potential impacts on protected species, are described in detail in the Biological Assessment.

2.2 MANMADE ENVIRONMENT

2.2.1 Population

2.2.1.1 Demography--

During the 1960s, the composition of Brevard County changed from a predominantly rural and military county to urban. A greater change in population composition occurred in the 1970s with an increasing number of retirees entering the county. The 1980 trends are reflecting another change in population composition; the majority of the population is between the ages of 25 and 65, indicating the change experienced in the economy during the late 1970s and early 1980s. Brevard County's population in 1984 was 323,055 with major urban area located in the cities of Cocoa (16,848), Melbourne (51,116), Palm Bay (31,276), and Titusville (36,701). The population projection for the year 2000 is estimated at 491,700, a 52.2-percent increase from 1984 statistics.

All military personnel at CCAFS are assigned to PAFB and perform their duties at CCAFS. The majority of the persons employed onbase are contractor personnel associated with the companies associated with the missile testing and space launch operations. No permanent residents are located onbase; all personnel are either stationed at PAFB, or reside in the local communities.

Impacts--The refurbishing of Launch Complex 41 will not require additional operational personnel; operational personnel will be from the current employment pool at CCAFS. Construction personnel will be provided by the subcontractors employed by Martin Marietta and are expected to be available in the existing labor force of Brevard and neighboring counties.

2.2.1.2 Housing--

In 1984, the average household size in Brevard County was 2.56 persons. The majority of the dwelling units within Brevard County were owner-occupied. In 1983, approximately 25.4 percent of the total number of dwelling units (113,900) was renter-occupied units, and the county experienced a vacancy rate of 10.6 percent.

No military housing is available onbase at CCAFS. All military personnel either reside at PAFB or within the surrounding communities.

Impacts--The Launch Complex 41 renovation and the launching of Titan 34D7 will create no impact on housing as no additional permanent personnel are expected beyond those currently employed at CCAFS.

2.2.2 Socioeconomics

2.2.2.1 Land Use Compatibility--

CCAFS is located on approximately 15,800 acres of the Cape Canaveral Barrier Island in Brevard County. The station is bounded by the KSC on the north, the Atlantic Ocean on the east, the City of Cape Canaveral on the south, and the Banana River and Merritt Island Wildlife Refuge on the west. Areas of urban growth are located at Cape Canaveral (0.5 mile south), Titusville (12 miles northwest), Cocoa (7 miles southwest), Cocoa Beach (8 miles south), and PAFB (15 miles south).

CCAFS is Station No. 1 of the Eastern Test Range (ETR) developed in the 1950s. The primary function of the station is to provide launch, tracking, and other facilities in support of DOD, NASA, and other range user programs. Approximately 30 percent of the station is developed and consists of launch complexes and support facilities (see Figure 2.2-1). The remaining 70 percent consist of unimproved land.

CCAFS houses 41 launch complexes, many of which are dismantled or have been deactivated. The base also contains a small industrial area (located at the eastern end of NASA Causeway East), Air Force Space Museum, Canaveral Harbor for the docking of submarines, NASA Mission Control, and a skid strip which was initially constructed for research and development recovery operation for missile launches. Many of the hangars located onbase are used for missile assembly and testing. Future land use patterns are expected to remain similar to current onbase conditions.

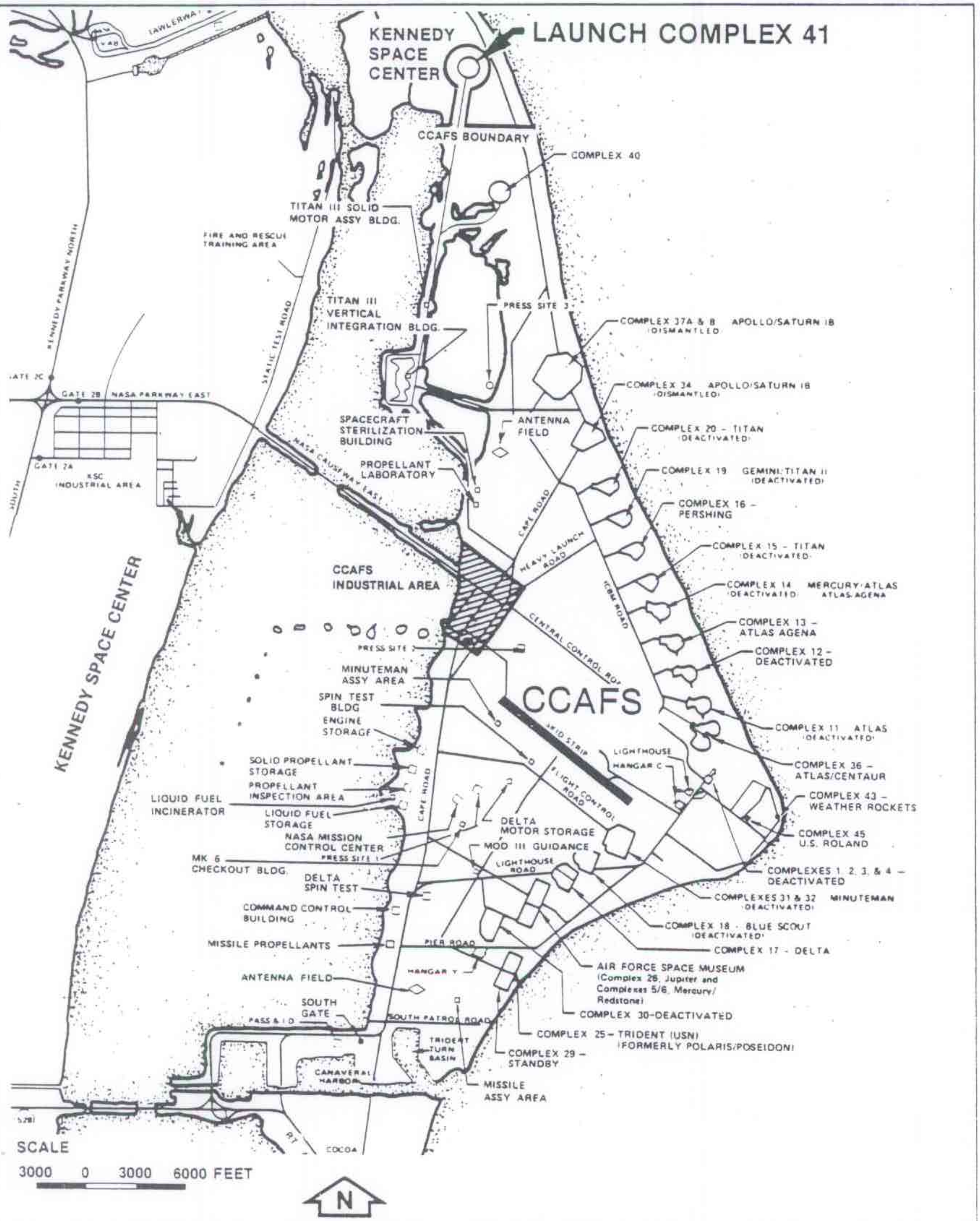

Figure 2.2-1
EXISTING LAND USE

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Environmental Assessment
Cape Canaveral Air Force Station

Launch Complex 41 is situated on 28.4 acres and is located on the northermost section of CCAFS. Launch Complex 41 was used in conjunction with Launch Complex 40 for test flights of the Titan IIIA and IIIC and Centaur vehicles in the early 1960s.

Impacts--Because the site was associated with space launches and the land area has been disturbed, these modifications will not create any adverse impacts on existing land uses adjacent to Launch Complex 41. In addition, all existing land uses onbase are expected to continue, and the refurbishing of Launch Complex 41 is not expected to impact current conditions.

2.2.2.2 Community Facilities and Services--

Potable Water Supply--Central Brevard County, with the exception of Merritt Island, is supplied with potable water from the City of Cocoa, and its well-field in Orange County has a capacity of 32 million gallons per day (MGD). CCAFS is under contract with the city and receives water through a 24-inch main, with a capacity of 3 MGD. Launch Complex 41 receives its water through a 36-inch main. Launches require a flow rate of 30,000 gallons per minute for a duration of 10 minutes. Therefore, flow rate to the complex must be constant. The distribution system at CCAFS was constructed for activities requiring large quantities of water, and current capacity is not expected to require further expansion. No impacts are expected.

Wastewater Treatment and Disposal--Launch Complex 41 is equipped with its own wastewater package plant located adjacent to the launch complex. The plant capacity is 13,000 gpd, and the plant currently is operating at a capacity of less than 1,000 gpd. Based on the estimated number of personnel located at Launch Complex 41, the plant's capacity is adequate to provide sanitary wastewater treatment. In addition to the package plant, the complex is equipped with a drainfield for wastewater effluent disposal. Because the package plant is not operating near capacity, no adverse impacts or additions to the plant are expected.

Solid and Hazardous Waste Collection and Disposal--All solid waste is collected by range contractor and disposed of onbase. The landfill is located 400 ft northeast of the CCAFS skid strip and has a life expectancy of 30 years. The landfill currently operates at 13,000 tons/year and accepts all solid waste from PAFB.

Hazardous wastes are accumulated at a number of locations throughout CCAFS to await disposal. Hazardous wastes are collected for up to 90 days at the accumulation or satellite stations before transfer to one of three CCAFS hazardous waste storage facilities. Wastes are stored at these locations for eventual shipment off-station to a licensed hazardous waste treatment/disposal facility.

Energy--CCAFS is serviced by Florida Power and Light Company (FPL) through a 240/138 kilovolt (kV) switching station. Launch Complex 41 is serviced by 13.2 kV lines and a substation located approximately 2 to 3 miles south of the complex. Estimated energy consumption for Launch Complex 41 in 1984 was 196,000 kilowatts (kw). Launches will occur periodically, and no additional energy generation is expected.

Police Service--CCAFS has no agreement with local police departments. Pan Am Security (Range Contractor) conducts all police services onbase. However, CCAFS will loan support to the local departments if necessary. Because no increase in employment is expected, increased security is not expected.

Fire Protection--A mutual agreement exists between the City of Cape Canaveral, KSC, and the Range Contractor at CCAFS. Because no new complexes are being constructed, no adverse impacts are expected. In addition, it is estimated that no additional equipment is expected.

Health Services--CCAFS is equipped with a dispensary under contract to NASA. The dispensary handles accident cases, physical examinations, and emergencies that occur to the work force. The dispensary is staffed during all phases of missile launches, but otherwise works on a 40-hour work week. If medical service cannot be provided by the dispensary, hospitals at PAFB and in Cocoa, Titusville, and Melbourne are used. An increase in medical facilities is not anticipated because launches are expected to be periodic.

Educational Facilities--No educational facilities are present on CCAFS. All military and civilian personnel are located either at PAFB or the urban areas in Brevard and surrounding counties. All school-age children attend school in the vicinity in which they live. An increase in school-age children is not anticipated because no additional employment is expected for renovation or operation of Launch Complex 41.

Recreation--No recreational facilities are present on CCAFS, except for those associated with the Trident Submarine Wharf. A service club and naval recreation facility consisting of ball fields, tennis, basketball, and volleyball courts. Cultural facilities onstation include the museum, tow facilities, and Mission Control. These are located at the southern portion of the base. Offbase military and civilian personnel utilize recreational and cultural facilities available within the communities. Launch Complex 41 renovations and operations will not have any impact on onbase or offbase recreational facilities.

Transportation--

Highways--Brevard County is serviced by Federal, state, and local roads. CCAFS is linked to this system by the South Gate via State Road (SR) A1A, NASA Causeway, and Cape Road. Primary highways in Brevard County include Interstate 95 (I-95), U.S. 1, SR A1A, and SR 520. Urban areas on the beaches and Merritt Island are linked by causeways and bridges.

Onbase transportation (see Figure 2.2-2) provides access to launch complexes, support facilities, and industrial area. Transportation onbase is limited to private vehicles and NASA bus tours. Highway

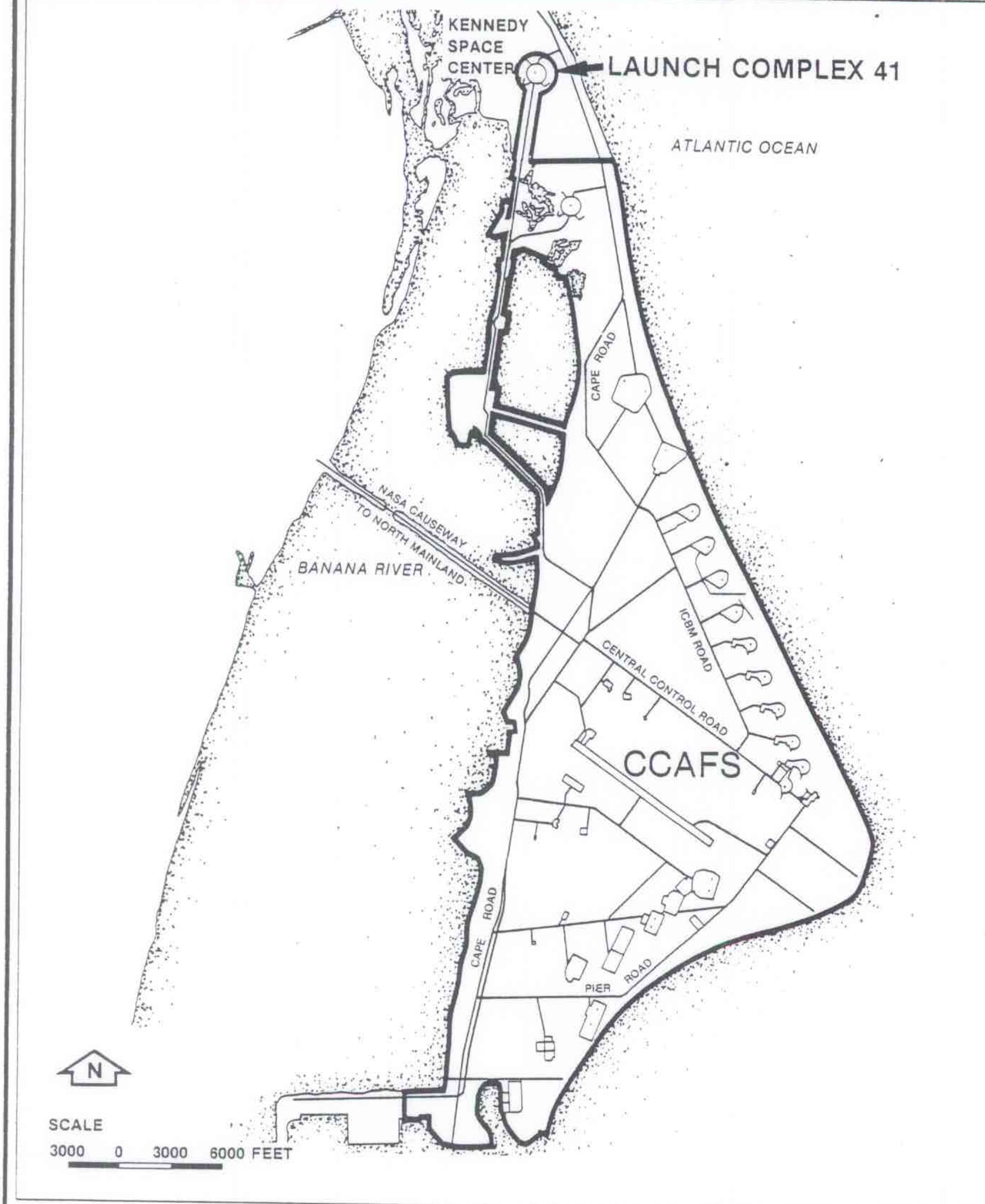

Figure 2.2-2
TRANSPORTATION NETWORK CCAFS

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Cape Canaveral Air Force Station

improvements (e.g., the repaving of access roads) have been completed onbase.

Refurbishing of Launch Complex 41 will increase onbase transportation to the launch complex for a short period of time. However, once renovations are complete, the traffic flow will be reduced to employees associated with launch operations and maintenance of facilities.

Rail--Rail transportation for Brevard County is provided by Florida East Coast Railway. A mainline traverses the cities of Titusville, Cocoa, and Melbourne. Spur lines provide access to other parts of the county. Launch Complex 41 is serviced by a branch line from Titusville through KSC. Maintenance of this line from the interchange north of Launch Complex 41 and launch pad is the responsibility of USAF. Refurbishing and launch operations at Launch Complex 41 will not have an adverse impact on the current rail system onbase or offbase.

Air Transportation--Several commercial and general aviation facilities are located in the region, primarily in southern Brevard and Orange Counties. Melbourne Regional Airport is the closest facility and is located 30 miles south of CCAFS. CCAFS contains a skid strip used for government aircraft and delivery of launch vehicles. Any air freight associated with the renovation or operation of Launch Complex 41 is anticipated to use the CCAFS skid strip.

Harbors--Port Canaveral is an accessible seaport and is located adjacent to the Trident Wharf at the southern portion of CCAFS. The port provides facilities for industrial and commercial activities and is becoming a prominent area for cruise ships. Renovation of Launch Complex 41 will create no adverse impacts to the port. In addition, the receiving of materials for construction will not create increased activity at the port.

2.2.2.3 Economy--

Employment--The total 1984 labor force in Brevard County was approximately 140,134 persons, with an unemployment rate of 5.3 percent. The majority of the resident workers are employed in service, manufacturing, and retail trade. Examples of major employers in Brevard County are KSC, Port Canaveral, Martin-Marietta, Harris, and Dictaphone. Approximately 9.1 percent of Brevard County's employees are employed in government-related enterprises. In addition, many employees in Brevard County commute from surrounding counties.

Employment at CCAFS is a combination of military and civilian personnel, all associated with the USAF. Launch Complex 41 employs a combination of USAF, ETR, NASA, KSC, military, and Martin-Marietta personnel for operations. Martin Marietta expects to employ 15 to 18 subcontractors to perform all construction work in 1986-87. All renovation employees will work a 40-hour work week, and completion of the project is expected in October 1988. Hired subcontractors will be responsible for their employees and payrolls. Operations employment will work 40-hour work weeks except when launches are planned, then personnel are present 24 hours through launch completion.

Operations at Launch Complex 41 are not expected to create any adverse impacts as all employees will be on the present payroll of KSC, Martin-Marietta, and those military personnel stationed at CCAFS. Renovation employees are expected to come from the present labor force of Brevard County and surrounding counties; therefore, no adverse impacts on employment are anticipated.

Income--The 1983 per capita income for Brevard County was $11,481. Total personal income for the county was $2.42 million, with government-related income totaling 18 percent ($0.44 million). Military income contributed $0.08 million of the government-related income in 1983.

Per capita income for those employed at CCAFS is expected to be equivalent to the average county income. Because no increase in employment is expected, average annual wages onbase are not expected to change.

2.2.3 Safety

Safety aspects of pre-launch, launch, and post-launch phases of the proposed CELV program are described in the Titan 34D7 ARAR (11). This ARAR is applicable to the Titan 34D7 flight vehicle, support equipment, and Complex 41 facilities. A copy of the Titan 34D7 ARAR is shown in Appendix A.

The purpose of the Titan 34D7 ARAR is to provide the system users/operators a comprehensive description of the hazardous subsystems and operations associated with the Titan 34D7. It provides a comprehensive identification and evaluation of the accident risks assumed during the processing and operation of the Titan 34D7 throughout its lifecycle. It also provides the means of substantiating compliance with program safety requirements and it will summarize all system safety analyses and testing performed on each system as required by USAF and DOD. The results of this assessment have identified design and operating limits to be imposed upon system elements to preclude or minimize accidents which could cause injury or damage.

2.2.4 Noise Pollution

2.2.4.1 Noise--

Significant sound levels are generated in the operations of rocket engines and launch vehicles. Noise is generated from the following sources:

1. Combustion noise emanating in the rocket chamber,
2. Jet noise generated by the interaction of the exhaust jet with the atmosphere,
3. Combustion noise resulting from the post-burning of the fuel-rich combustion products in the atmosphere, and
4. Sonic booms.

The major noise source in the immediate vicinity of the launch pad is the combination of noise in the combustion chamber, the interaction of the exhaust jet with the atmosphere, and the post-burning of fuel-rich combustion products in the atmosphere. The nature of the noise may be described as intense, of relatively short duration, composed predominantly of low frequencies, and occurring infrequently.

Both the acoustic power emitted and frequency spectrum of the noise is affected by the physical size of the rocket engine, its thrust level, and the specific impulse which relates to the selected propellants. Table 2.2-1 and Figure 2.2-3 show approximate overall sound pressure levels for the Titan III space launch vehicle versus distance from the source. Because the Titan 34D7 has a greater thrust than the Titan III vehicle, noise levels also can be expected to be greater. However, the noise impact is limited due to the rapid ascent of the vehicle, distance to uncontrolled areas, frequency of launches, and flight paths over the ocean.

During lift-off and during re-entry of suborbital and orbital stages, sonic booms are generated by space launch vehicles. These sonic booms are an inevitable effect of flight speeds in excess of that of sound. The intensity of the sonic booms is a function of the vehicle size, configuration, and velocity. Sonic booms will occur over the Atlantic Ocean, and will not impact developed coastal areas of Brevard County.

Impact on the Environment--Rocket propulsion systems generate acoustic energy fields that encompass an unusually wide frequency spectrum. Frequency components that contribute significant portions of the total acoustic energy range from below 1 hertz (Hz) to above 100,000 Hz, and this full spectrum has been considered in evaluating the impact of rocket engine operations on the environment. In considering acoustic criteria as these apply to rocket engine noises, it is necessary to consider not only the overall sound pressure level, but also the frequency spectrum and the duration of exposure. Sound durations are

Table 2.2-1. Estimated Maximum Ground-Level Sound Levels and Duration of Titan III C and D

Estimated Maximum Sound Pressure Level (dB re: 2×10^{-5} N/m^2)	Distance (miles)	Duration of Sound Within Range of 20 dB of Maximum (seconds)
182	0	7
136	0.5	
129	1	10 to 40
122	2	
112	5	20 to 80

dB = decibel.
N = newtons.
m = meter.

Sources: USAF, 1975.

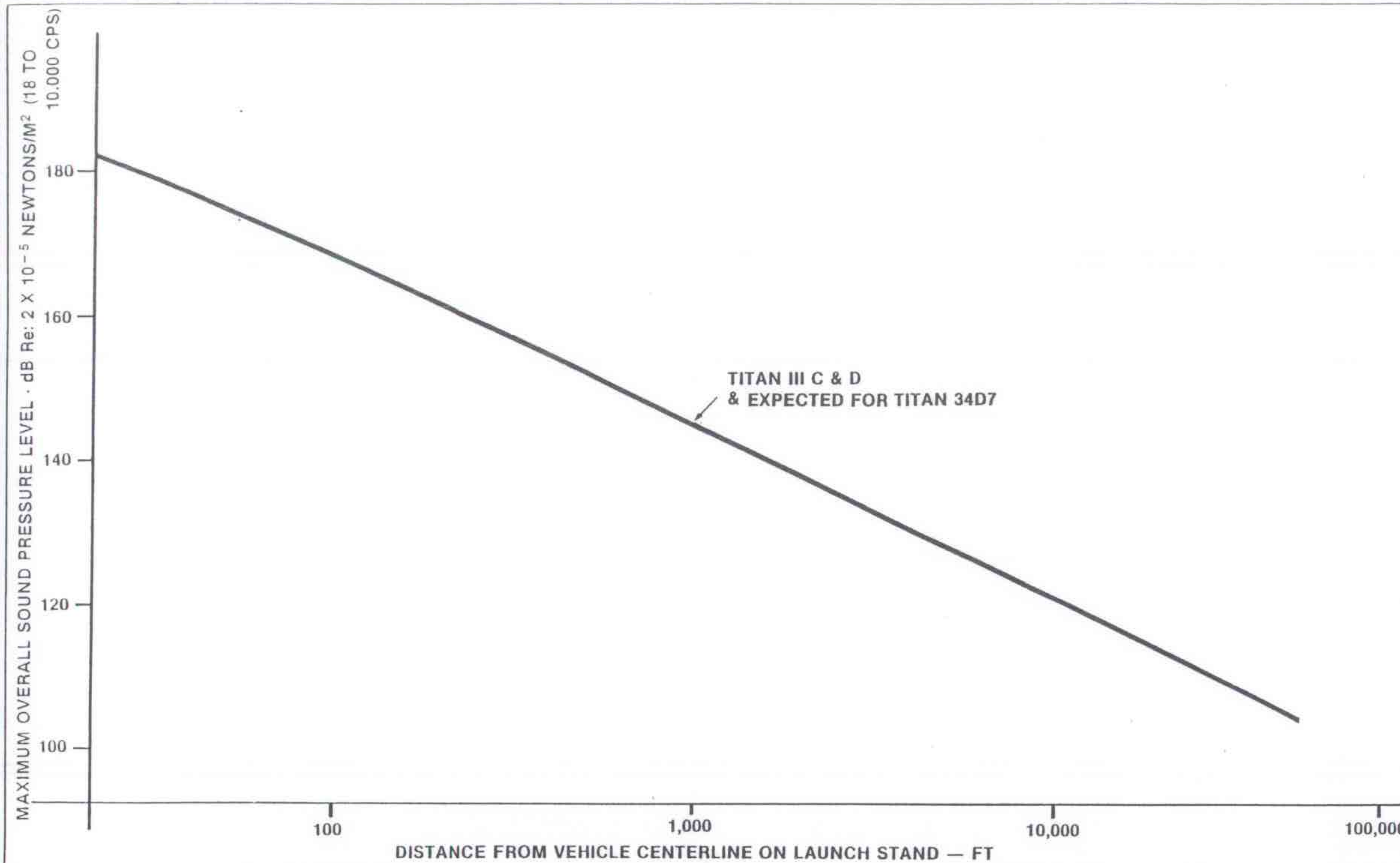

Figure 2.2-3
ESTIMATED MAXIMUM OVERALL SOUND PRESSURE LEVELS AT GROUND POSITIONS DURING LAUNCH OF TITAN III VEHICLES

SOURCE: ESE, 1985.

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Environmental Assessment
Cape Canaveral Air Force Station

short for rocket engine firings, and launches of the Titan 34D7 vehicle will be separated by many months.

Personnel required within the controlled area around the launch pad are either confined to structures which attenuate sound pressure to acceptable levels, or are provided with suitable ear protective devices. Road blocks are provided on access roads at a minimum of 2 miles away from the launch pads to exclude onbase personnel from hazardous areas at launch time. The predicted maximum sound pressure level (SPL) at this distance is 122 dBA (re: 2×10^{-5} N/m^2) for 40 seconds; less than the 125 dBA for 8 minutes allowed daily without exceeding the OSHA PEL (see Table 2.2-2).

At 10 miles from the launch pad, the maximum SPL is below 106 dBA. Both man and structures are safe in these sound fields for the time-duration typical of launch operations. At minimum distance to uncontrolled populations, the maximum, worst-case SPL would be approximately 95 dBA. This value was obtained by converting the Titan IIIC 20,000-ft frequency spectrum (see Figure 2.2-4) to dBA. The Titan 34D7 will have similar noise levels. Comprehensive short-term noise exposure standards for the general population are not published. However, considering the maximum SPLs anticipated in the uncontrolled areas and the very short exposure time, noise generated during launches will not affect the health of the general public. Vehicles have been launched from CCAFS for a number of years and are a part of the socio-economic environment. In the surrounding communities, the launch vehicle noise is usually perceived as a rumble in the distance. The noise element, at the worst, appears to be an infrequent nuisance rather than a health hazard. Because of the remote location of Launch Complex 41, noise levels are not expected to create adverse impacts.

2.2.4.2 Sonic Boom--

As any body moves through the air, the air must part to make way for that body and then close itself once the body has passed. In subsonic

Table 2.2-2. Permissible Noise Exposure (Occupational Personnel)

Duration Per Day (hours)	Sound Pressure Level (dBA; re: 2×10^{-5} N/m^2)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.2 or less	115

Note: Appropriate short-term standards for the uncontrolled (general) population have not been published.

Sources: OSHA, 1985.

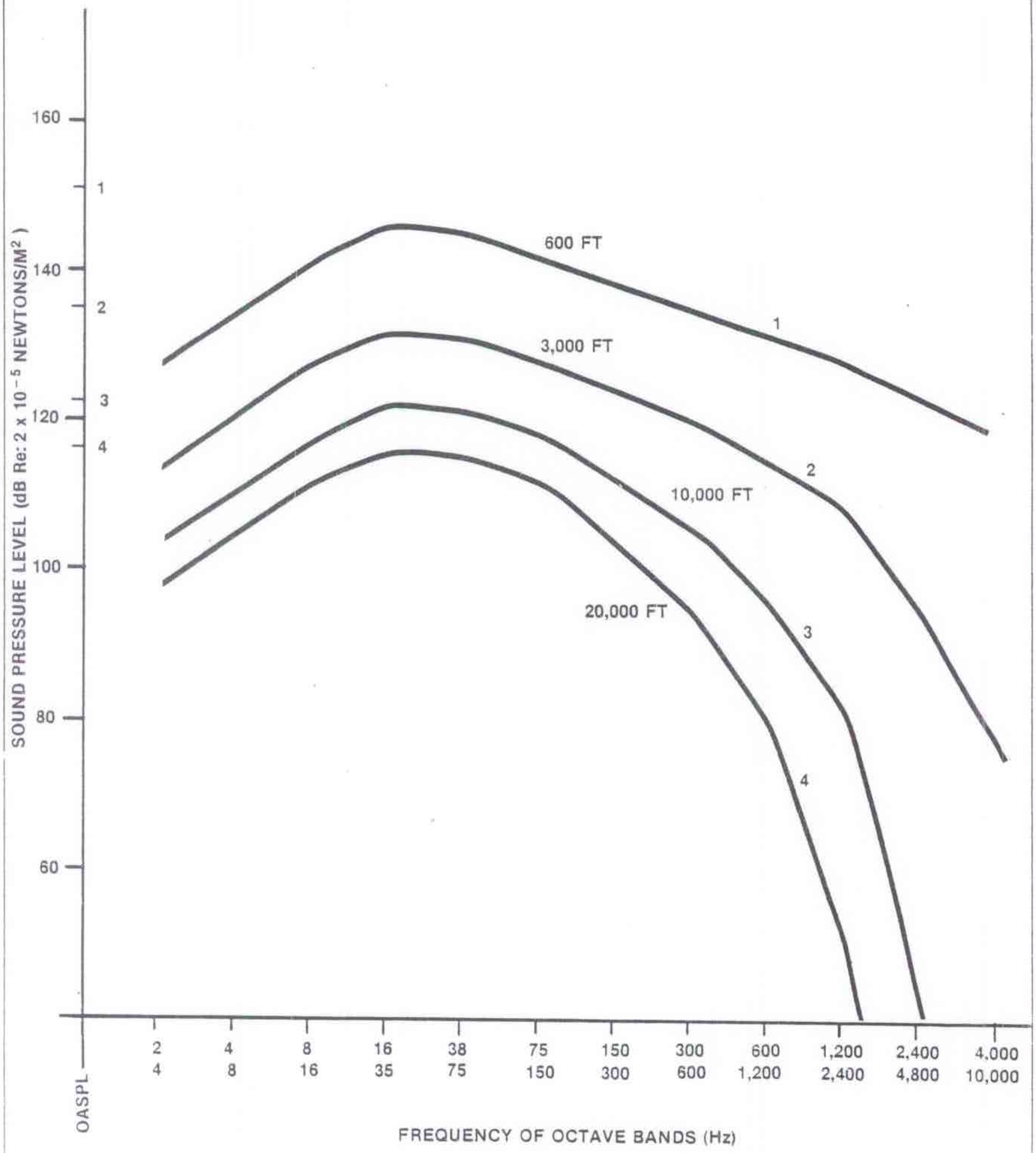

Figure 2.2-4
SOUND PRESSURE LEVEL SPECTRA FOR A TITAN III D AT FOUR DISTANCES

SOURCE: ESE, 1985.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

flight, pressure signals (precursor waves which travel at the speed of sound) move ahead of the body, and the parting of the air and the passage of the body is a smooth process. In supersonic flight, precursor waves cannot precede the body; the parting process is abrupt. A bow shock wave parts the air which expands as it passes around the body, and then a trailing shock wave recompresses the air as it closes behind the body. These waves travel through the atmosphere as pressure waves and, because of the abrupt noise they generate when passing an observer, are called sonic booms. The phenomenon occurs for all supersonic flights.

Impacts--The abruptness of the pressure changes is responsible for much of the concern about sonic booms. It gives the startling audibility and dynamic pressure characteristics of an explosion. In some cases of aircraft flight, even at great distances from the supersonic field where pressure levels produced are physically harmless, some public complaints are received.

The characteristics of the shock pattern and its source are influenced by flight path characteristics (i.e., altitude, speed, angle of attack, flight path curvature, and accelerations either along or transverse to the flight path) and body characteristics (e.g., bluntness, weight, exhaust plume characteristics, and volume). The pressure signature that reaches the surface of the earth is subject to the additional factors of air turbulence, winds, and temperature variations of the atmosphere traversed by the pressure wave, in addition to some flight path characteristics.

The ascent phase creates the largest sonic booms of a mission and is caused by two effects. First, overpressure that will be experienced over the ocean during supersonic ascent will be increased by the rocket exhaust plume which increases the effective size of the vehicle. NASA tests indicate that the overpressures may be as much as double those of the vehicle alone. The second effect is that of focusing caused by the pitchover maneuvers necessary for a vehicle to achieve orbit. Focusing results from the accumulation and reinforcement of the pressure waves in a limited region. The overpressures in the local zone will be limited to a very narrow margin at the ground track and the sonic boom will not be heard at the launch area.

Sonic booms also will occur during the descent of the spent suborbital booster stages and during the random re-entry of spent orbital stages. The overpressures resulting from these re-entries will be small compared to the ascent boom.

In the history of the USAF space launch vehicle operations from CCAFS, there have been no problems reported as a result of sonic booms. This is probably because the ascent track of all vehicles is over open ocean, and the planned re-entry of spent suborbital stages is also over open seas, thus placing sonic booms away from land areas where they can be experienced. Shipping in the area likely to be affected is warned of the impending launches as a matter of routine and the occurrence of the sonic boom, if it is observed at all, is expected and of no practical consequence.

2.2.5 Archaeological and Cultural Resources

An archaeological/historical survey of CCAFS was conducted in 1982. The survey consisted of literature and background searches and field surveys. It was determined that Cape Canaveral had been inhabited for 4,000 to 5,000 years. The survey located 32 prehistoric and historic sites and several uninvestigated historic localities. Site studies were conducted according to a sensitivity rating system devised by Resource Analysts, Inc. The initial results of the field survey indicated that many of the archaeological resources had been severely damaged by construction of roads, launch complexes, powerlines, drainage ditches, and other excavation. The survey identified 32 sites and recommended 11 for further evaluation to determine eligibility for the National Register of Historic Places. None of these sites are located in the vicinity of Launch Complex 41.

The protection and interpretation of significant resources associated with the space program is important, and attempts to maintain features associated with the Man in Space theme are underway by the Department of the Interior, National Park Service, and USAF through the Man in Space National Historic Landmark Program. Areas designated landmark sites include Mission Control Center and Complexes 5/6, 26, 34, 13, 14, 19, which were used during the Mercury and early Gemini manned space flights.

Impacts--Launch Complex 41 is located in the very northern portion of CCAFS. The area is highly disturbed and was not included in the archaeological survey. The closest recorded archaeological site (SR 221) is located approximately 4 miles north of Launch Complex 41. Because of the highly disturbed nature of Launch Complex 41, any archaeological resources present prior to construction of the launch complex have been destroyed, thereby reducing National Register eligibility. Launch Complex 41 has been evaluated and determined not to be part of the Man in Space National Historic Landmark Program. The renovation of Launch Complex 41 does not involve any additional excavation; therefore, no action taken to refurbish the launch complex will have an impact on any archaeological resource.

Aesthetics--Launch Complex 41 is located at the northern-most portion of CCAFS. Structures that will be visible will include the umbilical tower (180 ft high), mobile service tower (260 ft high), and propellant vent stacks. The only changes will be the addition of new platform levels. All control structures on the ground will be blocked from view by surrounding vegetation.

Because of the location of the launch complex (13.5 miles from residential and urban areas), no significant visual impact is expected.

3.0 REGULATORY REVIEW

3.1 AIR QUALITY

Air emissions within the State of Florida are regulated by FDER. FDER has established a program (implemented by 5) which requires a permit for the construction, modification, expansion, or operation of any facility that may be a potential source of air pollution. Under (5), exemptions are provided for air pollution sources which are mobile, specifically aircraft used for transportation of passengers and/or freight. Based on this exemption and current FDER policies as described in conversations with FDER personnel at both regional and state levels, no permits are required for exhausts from the launch vehicle itself. This exemption, however, does not include support facilities such as propellant loading systems.

According to the scheduled modifications to Launch Complex 41, air pollution control devices will be installed on the fuel and oxidizer storage handling systems. The proposed fuel vapor incinerator system (FVIS) consists of a propane-fired incinerator for the combustion of fuel vapors collected from pre- and post-launch operations. Oxidizer vapors resulting from similar pre- and post-launch operations will be controlled by a proposed oxidizer vapor scrubber system (OVSS). The OVSS consists of a series of packed towers over which a 25 percent solution of NaOH will flow countercurrent to oxidizer vapors.

Under (5), the oxidizer and fuel vapor air pollution control devices are subject to regulation. Chapter 17-2.210 FAC (5) requires that separate "Application to Operate/Construct Air Pollution Sources" (5) permit applications must be completed and submitted to FDER prior to the construction/installation of each control device.

The proposed FVIS and OVSS represent the Best Available Control Technology (BACT) for the control of emissions from fuel and oxidizer vapors associated with the proposed systems.

New or modified sources of air pollution must meet National Ambient Air Quality Standards for six types of pollutants: sulfur dioxide, particulate matter, CO, ozone, and lead. Based on the expected emissions, the FVIS and OVSS will meet National Ambient Air Quality Standards. Since CCAFS is not within a "non-attainment" area and these air pollution sources are considered minor (these sources emit less than 100 tons per year of a regulated pollutant), a "Prevention of Significant Deterioration" (PSD) review is not required.

FDER personnel indicated that if the regional FDER director determines that these air pollution sources are insignificant, an exemption can be made to waive the requirements for obtaining a permit for these sources. In order to receive an exemption, a letter describing the system, with attached schematics and any applicable emissions data, must be submitted to the FDER Regional Director in Orlando. However, this exemption is not permanent and may be revoked at any time. It is advisable, therefore, to forego an exemption and pursue a program that will bring all air pollution sources within Launch Complex 41 under full regulatory compliance.

3.2 WATER QUALITY

3.2.1 Industrial Wastewater Discharge

Wastewater discharges resulting from the CELV program operations will include deluge and fire suppressant waters and launch complex washdown waters. Deluge waters will be generated at an expected rate of 300,000 gallons per launch. An additional 100,000 gallons of water is estimated to be used for the combined purpose of fire suppressant and launch complex washdown. Some of the water will be collected in the flame bucket; the remaining water will flow off the pad and will percolate into the ground.

Approximately 30 to 40 percent of the deluge water will be collected in the flame bucket with the remaining deluge water, fire suppressant, and washdown water flowing directly to grade. After the initial launches, samples of the flame bucket water will be collected and analyzed for pH, hydrazine, nitrogen tetroxide, specific conductance, state and Federal primary and secondary drinking water standards, and synthetic organic chemicals listed in 9, including purgeables, pesticides, base neutral extractables, and acid extractables. If no detectable levels are found, and the flame bucket water meets the primary and secondary drinking water quality standards, the flame bucket water will be pumped to grade at Launch Complex 41 and allowed to infiltrate into the ground. If the flame bucket wastewater contains any detectable levels of toxic or hazardous compounds and/or does not meet the primary and secondary drinking water quality standards, the wastewater will be handled in accordance with applicable Federal and/or state regulations. The deluge, washdown, and fire suppressant waters, which run off the launch complex, are not expected to be contaminated and therefore will not require retention and treatment. To ensure compliance, samples of runoff water will be collected and analyzed from the next launches at Launch Complexes 40 and 41. If runoff water quality is found to exceed criteria, appropriate action will be taken.

The sampling and analysis of the flame bucket water from subsequent Titan 34D7 launches will depend on the results of the analysis of Launch Complex 40 water, and from the initial launch results from Launch Complex 41.

An "Application to Operate/Construct an Industrial Wastewater Treatment and Disposal System" permit [DER Form 17-1.204(2)], and a ground water monitoring plan may be required prior to launch operations at Launch Complex 41. FDER issues Industrial Waste Discharge Permits and approves Ground Water Monitoring Plans in accordance with 6, 7, and 8.

The flame bucket wastewater will be discharged to the infiltration field at a rate which will not exceed the minimum infiltration rate of the soils within the infiltration field. Controlling the rate of discharge will ensure that no wastewater will flow to nearby surface waters and eliminates the need for a National Pollutant Discharge Elimination System (NPDES) permit.

3.2.2 Stormwater Drainage

Florida's stormwater discharge permitting program (as implemented by 10) is designed to prevent adverse effects on surface water quality from stormwater runoff. Based on the current policies and discussions with FDER and St. Johns River Water Management District personnel, Launch Complex 41 is currently exempt from the stormwater permitting program because the renovation of Launch Complex 41 will not increase stormwater runoff rates or reduce the quality of the existing runoff.

3.2.3 Surface Water Management

Florida's surface water management program is administered by the St. Johns River Water Management District and is designed to regulate post-development runoff water quality and quantity from exceeding pre-development conditions. Launch Complex 41 was constructed before the January 31, 1977 Surface Water Management Program implementation date and is, therefore, exempt from regulation under this program.

3.2.4 Sanitary Wastewater Discharge

Sanitary wastes produced at Launch Complex 41 are treated in an onsite extended aeration treatment plant. The design capacity of the treatment system is 13,000 gpd. FDER regulates all domestic wastewater treatment facilities with sewage flows over 5,000 gpd. Wastes discharged from the treatment system flow to an adjacent percolation/infiltration system. CCAFS is currently in the process of obtaining a permit (DER Form 17-1.205) for the operation of this domestic wastewater treatment/disposal system. This permit will be required prior to ILC and issuance of the permit is expected in late 1986.

3.3 HAZARDOUS WASTES

Hazardous wastes that will be produced at Launch Complex 41 as a result of the CELV program operations are currently permitted under RCRA. CCAFS was issued a RCRA Part B Hazardous Waste Operations permit in January 1986. Hazardous wastes which are expected to be generated at Launch Complex 41 are listed in Table 3.3-1.

Launch Complex 41 is expected to have several small hazardous waste accumulation areas located throughout the launch complex for the collection of hazardous wastes produced from CELV operations. Hazardous wastes will be accumulated at these areas for up to 90 days, before being transferred to a CCAFS hazardous storage area. These wastes will eventually be transported to an off-station licensed hazardous waste treatment/disposal facility.

3.4 SPILL PREVENTION

EPA's Oil Pollution Prevention Regulation (34) requires facilities to prepare and implement a plan to prevent any discharge of oil (petroleum products) into waters of the United States. This plan is referred to as the Spill Prevention Control and Countermeasure (SPCC) Plan. CCAFS currently operates under a SPCC plan. However, a 1,200-gallon aboveground diesel-fuel tank (Facility 29100U) located at Launch Complex 41 has no secondary spill containment as required under the SPCC plan. Prior to ILC, this diesel fuel tank at Launch Complex 41 will have to be bermed in accordance with the CCAFS SPCC plan.

3.5 COASTAL MANAGEMENT PROGRAM

Federal agency activities in or affecting Florida's coastal zone must comply with Section 307 of the Federal Coastal Zone Management Act (CZMA), 16 U.S.C. Section 1456(c), and the National Oceanic and Atmospheric Administration (NOAA) implementing regulations, 15 CFR Part 930. These regulations require that Federal agencies ensure that their undertakings are consistent to the "maximum extent practicable" with the

Table 3.3-1. Expected Hazardous Wastes Produced from CELV Operations*

Aerozine 50 (Hydrazine and UDMH)
Hydrazine
Nitrogen tetroxide
NaOH
H_2O_2
OVSS Liquor (NaOH)
Chlorinated solvents

*Based on past Launch Complex 40 records and proposed industrial systems at Launch Complex 41.

Source: USAF HQ AFESC/DEVP, 1984.

NOAA-approved state Coastal Management Program (CMP) for actions that may have direct impacts on the state's coastal zone.

The purpose of this consistency determination is to assure that the Federal activities are planned and implemented to be consistent to the "maximum extent practicable," with the federally approved state CMP.

In Florida, the Governor's Office of Planning and Budgeting (OPB) coordinates the evaluations and develops a recommended state response. FDER, as lead agency for CMP, provides formal state consistency response. As stated in 15 CFR 930, Federal activities on Federal property are excluded from state-designated coastal zones. If the activity has impacts off Federal property that result in direct impact to the state coastal zone, these activities must be consistent. In addition, the State of Florida specifically excludes Federal defense facilities from the state's coastal zone based on Sections 305(b)(1) and 304(1) of the CZMA. Therefore, CCAFS (including Launch Complex 41) has been excluded from the State of Florida CMP. In addition, on basis of compatible land use, absence of significant environmental impact, and compliance with applicable regulations, the proposed CELV program at Launch Complex 41 of CCAFS is found to be consistent to the "maximum extent practicable" with the goals and objectives of the Florida CMP.

3.6 ENDANGERED SPECIES

The Federal Endangered Species Act of 1973 (as amended) extends legal protection to plants and animals listed as endangered or threatened by USFWS. Section 7 of the Endangered Species Act (the Act) authorizes USFWS to review proposed Federal actions to assess potential impacts on such listed species.

USAF is cognizant of the importance of protecting endangered and threatened species, and their Critical Habitats. USAF began an early consultation process with USFWS Endangered Species Office, Jacksonville, Florida, to identify potential areas of concern. A copy of the USAF notification letter, along with the USFWS response, is attached in Appendix B.

In accordance with Section 7(c) of the Act, USAF has prepared a Biological Assessment for those endangered and threatened species known or expected to occur in the vicinity of Launch Complex 41. This Biological Assessment addressed the modifications to the existing structures, and subsequent launch operations, or endangered and threatened species, and included a "no jeopardy" opinion. The USAF will file the Biological Assessment and the "no jeopardy" opinion with the USFWS.

In addition to species listed by USFWS, Florida Game and Fresh Water Fish Commission protects additional species listed as endangered or threatened under Florida's Endangered and Threatened Species Act of 1977 (as amended). The status of such species in the vicinity of Launch Complex 41, and any potential impacts resulting from the CELV program are discussed in Section 2.1.7.3 of this document.

4.0 MITIGATION

4.1 AIR QUALITY

Potential impacts on air quality from releases of fuel and oxidizer will be minimized by the installation of the proposed air pollution control devices. Schematic diagrams of the proposed FVIS and the proposed OVSS are presented in Figures 2.1-6 and 2.1-7, respectively.

The FVIS controls fuel vapors through combustion in a propane-fired incinerator (see Figure 4.1-1). Fuel vapors are generated during bulk fuel transfer, fuel system checkout (RSV, Stage I vessel, and Stage II vessel pressurizations), and post-launch fuel system purgings. These vapors will be collected and incinerated in the FVIS. The FVIS will control fuel vapors for approximately 12 to 15 hours per launch.

Other fuel vapors are produced as the result of scheduled and unscheduled fueling system maintenance. The system is purged with nitrogen to reduce emissions to the lowest practical limit prior to maintenance operations, such as the exchange of filters. No mechanisms exist for the capture and treatment of these vapors.

This OVSS controls oxidizer emissions through a series of packed towers over which a 25 percent NaOH solution will flow countercurrent to oxidizer vapors. Oxidizer vapors are generated in the same manner as fuel vapors.

Unexpected ventings of fuel or oxidizer directly to the environment through emergency situations may cause an adverse impact on air quality around Launch Complex 41. The chances of an emergency venting occurring are minimal when considering the amount of safety backups on the propellant loading systems. Emergency venting would only occur in the unlikely event of FVIS or OVSS equipment failure. The FVIS and OVSS will be used for all scheduled and normal operations. Since operational

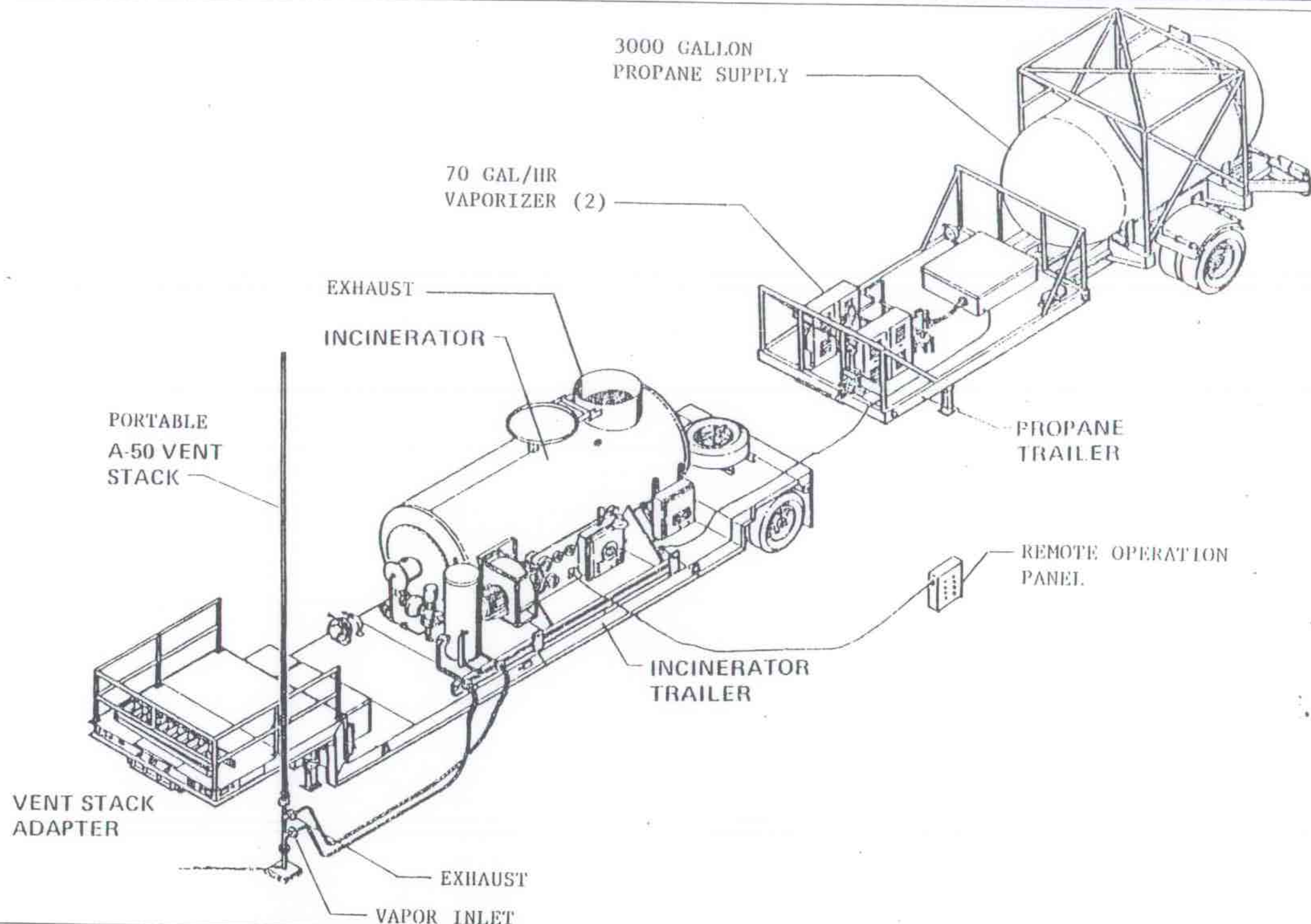

Figure 4.1-1
FVIS - CURRENT CONFIGURATION FOR TITAN II PROJECT
SOURCES: Martin Marietta, 1985.

CELV
Environmental Assessment
Cape Canaveral Air Force Station

startup of the Titan program at CCAFS in 1963, no emergency propellant ventings have occurred.

Based on the emission rates of the FVIS and OVSS, the CELV program is not expected to have a significant impact on air quality at Launch Complex 41.

4.2 SOILS

The CELV program is not expected to have negative effects on the soils surrounding Launch Complex 41. No extensive excavations will be required during the refurbishment. The Complex 41 area is sodded and does not adjoin any surface waters.

4.3 WATER QUALITY

4.3.1 Ground Water

Potential contamination of ground water resulting from accidental or emergency spills of propellants will be mitigated through adherence to strict safety procedures. Accidental or emergency spills of propellants will be mitigated through the use of catch basins surrounding propellant storage tanks, waste storage tanks, and a collection basin at the oxidizer storage facility. In addition, any accidental or emergency release of propellants from the Titan vehicle will be collected in the flame bucket located directly beneath the launch vehicle. Any potential contaminants collected in the flame will be disposed of in accordance with appropriate state and Federal regulations. Analysis of flame bucket water prior to discharge to grade, in accordance with applicable Federal and/or state regulations, will safeguard ground water quality from contamination.

The analysis of flame bucket water will identify any contaminants present prior to discharge to grade. If the flame bucket water is found to be contaminated, it will be disposed of in accordance with applicable state and Federal regulations. Analysis of flame bucket water prior to disposal will follow the procedures discussed in Section 3.2 of this report. No discharge of contaminated water will result from launch activities at Launch Complex 41.

4.3.2 Surface Water

Any potential impact to surface water quality due to on-pad accidents will be mitigated by the high degree of reliability of the Titan 34D7 vehicle. Potential impacts of the exhaust cloud on surface water quality will be mitigated by the relatively long distance between Launch Complex 41 and the Banana River and dispersion of the exhaust cloud.

A sampling program currently is underway to characterize both the quantity and quality of water collected in the flame bucket and the quantity and quality of water that runs directly to grade from the launch pad during launch. Both the flame bucket water and the runoff water will be handled according to the results of the monitoring study.

Runoff and/or accidental spills in fuel storage areas at Launch Complex 41 will be contained in existing catch systems. Accidental spills from the launch vehicle will be retained in the flame bucket. Fuel storage facilities and transfer activities at Launch Complex 41 will be included in the CCAFS SPCC.

4.4 BIOTA

The CELV program is not expected to have negative impacts on the local or regional biota. No natural habitats will be destroyed during construction and the complex does not adjoin any unique vegetation communities or critical wildlife habitats. The specific impacts of the CELV program on endangered species has been addressed in a Biological Assessment and a "no-jeopardy" opinion prepared as part of the Section 7 consultation process with USFWS.

4.5 POPULATION

4.5.1 Demography and Housing

The refurbishing of Launch Complex 41 will create no significant impact on population and housing on CCAFS. Because the complex is expected to utilize existing personnel onbase, no mitigation measures are necessary.

4.6 SOCIOECONOMICS

4.6.1 Land Use Compatibility

Launch Complex 41 was established during the 1960s for testing of Titan and Centaur missiles. The refurbishing of the existing complex is compatible with present land uses; therefore, no mitigative measures are necessary.

4.6.2 Community Facilities and Services

All necessary utility services are present at Launch Complex 41 and have sufficient capacity to service the launch complex during operations. No mitigative measures are necessary.

4.6.3 Transportation

Sufficient transportation access is available for Launch Complex 41. Access is available by Cape Road on the north and south of the complex. Mitigation measures to provide accessibility are not necessary.

4.6.4 Economy

Launch Complex 41 renovation is being conducted by Martin-Marietta under contract to USAF. Additional employment for renovation and operation are not required because currently employed personnel will be used. Mitigation measures to reduce impacts are not necessary.

4.7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Complex 41 does not contain any unique archaeological or historical resources. In addition, no new construction is required off-site for the refurbishment of Launch Complex 41. As a result, the CELV program is not expected to have adverse effects on the area's archaeological and historical resources.

4.8 AESTHETICS

No significant impact to visual resources will occur.

4.9 HAZARDOUS WASTES

All hazardous wastes produced by the CELV program will be managed in accordance with applicable Federal and state regulations.

4.10 NOISE

The rocket engine noise at lift-off of the USAF space launch vehicles can be characterized as being very intense but of relatively short duration, and composed of predominantly low frequency energy. In addition, sonic booms will be experienced both during the lift-off and during the return of sub-orbital space launch vehicle segments and during the random reentry of orbital segments.

The infrequency of launches and the remote location of Launch Complex 41 on the north end of CCAFS will minimize the noise impact of the CELV program. In addition, the retention of the muffler on the Centaur GN2 high pressure relief valve would provide noise reduction if venting is required. The CELV program is compatible with the surrounding land-use at KSC and CCAFS.

5.0 LIST OF AGENCIES AND INDIVIDUALS CONTACTED

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APPENDIX A--734D7 ACCIDENT RISK ASSESSMENT REPORT

MCR-85-2514

T34D7 ACCIDENT RISK ASSESSMENT REPORT

PRELIMINARY

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FOREWORD

This T34D7 Accident Risk Assessment Report was prepared in response to contract F04701-85-C-0019, CDRL 014A2.

TABLE OF CONTENTS

TOPIC		PAGE
1.0	INTRODUCTION	1-1
2.0	PURPOSE	2-1
	2.1 MSPSP Approval	2-1
	2.2 Compliance Document Listing	2-1
3.0	SCOPE	3-1
	3.1 System Identification	3-1
	3.2 Support Systems	3-1
	3.3 Operational Interfaces	3-1
	3.4 Facilities	3-1
4.0	SAFETY CERTIFICATION	4-1
	4.1 ARAR's Completeness, Accuracy and Validity	4-1
	4.2 System Compliance with Contractual Safety Requirements	4-1
	4.3 Parameters for Safe Operation	4-1
	4.4 Qualified System Safety Engineer Certificate	4-1
5.0	PROGRAM SAFETY STATUS SUMMARY	5-1
	5.1 Safety Reviews	5-1
	5.2 System Safety Working Groups	5-1
6.0	SAFETY NON-COMPLIANCE ITEMS	6-1
	6.1 Waiver/Deviation Disposition	6-1
	6.2 Supporting Documentation	6-1
7.0	GENERAL SYSTEM DESCRIPTION	7-1
	7.1 Primary System	7-1
	7.1.1 System Overview	7-1
	7.1.2 Booster Stage 0, Solid Rocket Motors (SRM)	7-2
	7.1.3 Booster Vehicle Structure	7-4
	7.1.4 Booster Vehicle Propulsion Stage I, II	7-6
	7.1.5 Booster Vehicle Avionics	7-6

TABLE OF CONTENTS (Continued)

TOPIC PAGE

7.1.6 Booster Vehicle Software 7-10
7.1.7 Centaur Upper Stage 7-10
7.1.8 Inertial Upper Stage (IUS) 7-12
7.1.9 Payload Fairing (PLF) 7-12
7.2 Support System 7-14
7.2.1 Launch Complex 7-14
7.2.2 Structural and Handling 7-14
7.2.3 Aerospace Ground Equipment (AGE) 7-15
7.2.4 Safety Review and Criteria 7-15
7.3 Hazardous Subsystems 7-15
7.3.1 T34D7 Hazard Identification 7-15
7.3.2 Hazardous Materials and Components 7-15
7.3.3 Safety Critical Design 7-15
7.3.4 Safety Critical Operations 7-17

8.0 INTEGRATED GROUND OPERATIONS 8-1
8.1 Facilities Description 8-1
8.2 Processing 8-1
8.3 Flow Chart 8-1

9.0 FLIGHT OPERATIONS 9-1
9.1 Sequence of Events 9-1

10.0 RISK ASSESSMENT 10-1
10.1 Integrated Analysis Summary 10-1
10.2 Integrated Checklist 10-1
10.3 Risk Summary 10-1

TABLE OF CONTENTS (Continued)

TOPIC		PAGE
	ANNEX 1 CORE VEHICLE	
	(There will be an Annex for each element)	
1-1.0	DETAILED ELEMENT DESCRIPTION	A1-
	1-1.1 Primary System	A1-
	1-1.1.1 Structural/Mechanical Subsystems	A1-
	1-1.1.2 Ordnance Subsystems	A1-
	1-1.1.3 Pressurized Subsystems	A1-
	1-1.1.4 Propulsions and Propellant Subsystems	A1-
	1-1.1.5 Ionizing Radiation Producing Subsystems	A1-
	1-1.1.6 Non-Ionizing Radiation - RF and Command Subsystems	A1-
	1-1.1.7 Non-Ionizing Radiation - Optical and Laser Subsystems	A1-
	1-1.1.8 Electrical/Electronic Subsystems	A1-
	1-1.2 Ground Support Equipment	A1-
	1-1.2.1 Structural/Mechanical Subsystems	A1-
	1-1.2.2 Ordnance Subsystems	A1-
	1-1.2.3 Pressurized Subsystems	A1-
	1-1.2.4 Propulsions and Propellant Subsystems	A1-
	1-1.2.5 Ionizing Radiation Producing Subsystems	A1-
	1-1.2.6 Non-Ionizing Radiation - RF and Command Subsystems	A1-
	1-1.2.7 Non-Ionizing Radiation - Optical and Laser Subsystems	A1-
	1-1.2.8 Electrical/Electronic Subsystems	A1-
	1-1.3 Facilities and Interfaces	A1-
	1-1.3.1 Structural/Mechanical Subsystems	A1-
	1-1.3.2 Ordnance Subsystems	A1-
	1-1.3.3 Pressurized Subsystems	A1-
	1-1.3.4 Propulsions and Propellant Subsystems	A1-
	1-1.3.5 Ionizing Radiation Producing Subsystems	A1-
	1-1.3.6 Non-Ionizing Radiation - RF and Command Subsystems	A1-
	1-1.3.7 Non-Ionizing Radiation - Optical and Laser Subsystems	A1-
	1-1.3.8 Electrical/Electronic Subsystems	A1-

TABLE OF CONTENTS (Continued)

TOPIC	PAGE
1-2.0 SUBSYSTEMS DESIGN, OPERATING CHARACTERISTICS AND SAFETY ANALYSIS	A1-
1-2.1 Mechanical/Electrical Schematics	A1-
1-2.2 Control Circuitry Schematics	A1-
1-2.3 Controls and Operations	A1-
1-2.4 Safety Critical Parameters	A1-
1-2.5 Hazard Analyses	A1-
1-2.6 Major Components and Safety Criticality	A1-
1-3.0 GROUND PROCESSING OPERATIONS	A1-
1-3.1 Flow Charts	A1-
1-3.2 Sequence Description	A1-
1-3.3 Transportation and Handling	A1-
1-3.4 Hazard Analyses	A1-
1-4.0 FLIGHT OPERATIONS	A1-
1-4.1 Flow Charts	A1-
1-4.2 Sequence Description	A1-
1-4.3 Hazard Analyses	A1-
1-5.0 HAZARDOUS MATERIALS	A1-
1-5.1 Listing	A1-
1-5.2 Analyses	A1-
1-5.3 Assessment	A1-
1-6.0 PERSONNEL PROTECTIVE EQUIPMENT	A1-
1-6.1 Usage	A1-
1-6.2 Equipment Description	A1-
1-6.3 Performance Characteristics	A1-

TABLE OF CONTENTS (Continued)

TOPIC		PAGE
1-7.0	RISK ASSESSMENT	A1-
	1-7.1 Hazard Analyses Summaries (HA, OHA, IFHA, IOHA, etc.) and Reports	A1-
	1-7.2 Checklists	A1-
	1-7.3 Procedures	A1-
	1-7.4 Failure/Accident Record	A1-
	1-7.5 Waivers/Deviations	A1-
1-8.0	SAFETY CERTIFICATION	A1-

Annexes to be provided are:

1. Core Vehicle
2. Solid Rocket Motors
3. Payload Fairing
4. Stage 1 and 2 Liquid Engines
5. Guidance
6. Instrumentation
7. Centaur
8. IUS

	TABLES	PAGE
2-1	Safety Compliance Documents	2-1
5-1	Safety Review and Safety Working Group Action Items	5-2

	FIGURES	PAGE
7-1	Complementary Expendable Launch Vehicle (CELV)	7-2
7-2	Stage 0 Solid Rocket Motors	7-3
7-3	Booster Vehicle Structure	7-5
7-4	Stage I and II Propulsion	7-7
7-5	T34D7/Centaur Avionics Configuration	7-8
7-6	T34D7/IUS Avionics Configuration	7-9

TABLE OF CONTENTS (Continued)

TOPIC PAGE

FIGURES - cont'd

7-7	Centaur Upper Stage	7-11
7-8	IUS Upper Stage	7-13
7-9	Payload Fairing (PLF)	7-14
8-1	Launch Complex 41	8-2
8-2	Solid Motor Assembly Building	8-3
8-3	Vertical Integration Building	8-4
8-4	Motor Inert Storage Building	8-5
8-5	MST Environmental Shelter	8-6
8-6	Integrate-Transfer-Launch Facility	8-7
9-1	Typical Centaur Flight Sequence	9-2
9-2	Typical IUS Flight Sequence	9-3
10-1	T34D7 Operational Phases	10-2
10-2	T34D7 Unacceptable Conditions	10-3
10-3	Processing Phase vs Unacceptable Conditions	10-4
10-4	Preliminary Hazard Analysis	10-5
10-5	T34D7 Hazard Report Form	10-7

GLOSSARY OF TERMS

AFOSH	Air Force Occupational Safety and Health
AGE	Aerospace Ground Equipment
ARAR	Accident Risk Assessment Report
ATC	Aerojet TechSystems Company
ATP	Authority to Proceed
BAC	Beoing Aerospace Company
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CELV	Complementary Expendaole Launch Venicle
CI	Configuration Item
CSD	Chemical Systems Division
DID	Data Item Description
DOD	Department of Defense
ECP	Engineering Change Proposal
ESMC	Eastern Space and Missile Center
FMEA	Failure Modes and Effects Analysis
GDC	General Dynamic Corporation
GFD	Government Furnished Data
GFE	Government Furnished Equipment
GFP	Government Furnished Property
GSTP	Ground System Test Procedure
IARAR	Integrated Accident Risk Assessment Report
IFHA	Interface Hazard Analysis
IGS	Inertial Guidance System
ILC	Initial Launch Capability
IMU	Inertial Measurement Unit

GLOSSARY OF TERMS (Continued)

IOHA	Integrated Operating Hazard Analysis
ISHA	Integrated System Hazard Analysis
ISSA	Integrated Software Safety Analysis
ITL	Integrate-Transfer-Launch
IUS	Inertial Upper Stage
IV&V	Independent Validation and Verification
LC-41	Launch Complex 41
LRE	Liquid Rocket Engine
LSHP	Launch Site Hazardous Procedure
MDAC	McDonnell Douglas Astronautics Company
MGC	Missile Guidance Computer
MFSR	Missile Flight Safety Report
MSPSP	Missile System Prelaunch Safety Package
OHA	Operating Hazard Analysis
PDR	Preliminary Design Review
PHA	Preliminary Hazard Analysis
PLF	Payload Fairing
RAP	Risk Assessment Panel
RCS	Reaction Control System
RMIS	Remote Multiplexed Instrumentation System
RSDR	Range Safety Data (Report)
RSM	Range Safety Briefing/Memo
SCI	Spacecraft Incorporated
SD	Space Division
SDRL	Subcontractor Data Requirements List
SHA	System Hazard Analysis
SMAB	Solid Motor Assembly Building

GLOSSARY OF TERMS (Continued)

SRM	Solid Rocket Motor
SS	System Safety Practice for T3407 Program
SSA	Software Safety Analysis
SSCL	System Safety Checklist
SSG	System Safety Group
SSPP	System Safety Program Plan
SSWG	System Safety Working Group
STS	Space Transportation System
T&H	Transportation and Handling
TBD	To be determined
TBS	To be supplied
TRR	Test Readiness Review
TSA	Test Safety Analysis
TVC	Thrust Vector Control
UDMH	Unsymmetrical Dimethylhydrazine
VIB	Vertical Integration Building

1.0 INTRODUCTION

This Accident Risk Assessment Report (ARAR) has been prepared in accordance with DI-S-30565 as required by CDRL 014A2 of contract F04701-85-C-0019. This issue is the first of four incremental submittals leading to flight certification of the T34D7 as configured for the IUS. Appropriate updates are planned for the Centaur program.

The outline used for this draft submittal was informally approved at the second System Safety Working Group (Phase 0) held on 08Aug85. This draft ARAR provides that outline for formal concurrence by the purchasing office, as discussed at the 08Aug85 meeting.

It is intended that the ARAR will document the results of analytical tasks performed in response to MIL-STD-1574A as documented in the System Safety Program Plan, MCR-85-2101, CDRL 062A2, previously provided to the program office.

2.0 PURPOSE

The purpose of this ARAR is to provide the system users/operators a comprehensive description of the hazardous subsystems and operations associated with the T34D7 and its interfaces. It provides a comprehensive identification and evaluation of the accident risks assumed during the processing and operation of the T34D7 throughout its lifecycle. It also provides the means of substantiating compliance with program safety requirements and it will summarize all system safety analyses and testing performed on each system as required by MIL-STD-1574A. The results of this assessment will identify design and operating limits to be imposed upon system elements to preclude or minimize accidents which could cause injury or damage.

2.1 MSPSP Approval

This Accident Risk Assessment Report serves as the Missile System Prelaunch Safety Package and contains all the MSPSP required data.

2.2 Compliance Document Listing

The design and operations of the T34D7 have been/will be conducted in accordance with the safety related contractual compliance documents listed in Table 2-1 or appropriate waivers/devications will be requested, see Section 6.

Table 2-1
Safety Compliance Documents

*DOCUMENT	DATE	TITLE	SOURCE
Mil Std 1574A*	79 Aug 15	System Safety Program for Space and Missile Systems	SOW/SS-ELV-401
AFR 122-16	70 Sep 17	Nuclear Safety Review Procedures for Space Applications of Minor Radioactive Sources	SOW
AFR 127-100	71 Dec 02	Explosives Safety Manual	SOW
AFR 127-101	72 Sep 04	Ground Accident Prevention Handbook	SOW
AF ASPR Sup (02)	77 Jun 17	Accident Prevention	SOW
AFETRM 127-1	72 Sep 01	Range Safety Manual	SOW/SS-ELV-401
Vol I Change 3	81 Jan 05		
Vol II	74 Jun 15		
Mil Std 454H	82 Jul 30	Standard General Requirements for Electronic Equipment	SS-ELV-401
Mil Std 1512	72 Mar 21	Electroexplosive Subsystems, Electrically Initiated, Design Requirements and Test Methods	SS-ELV-401

*Indicates specific tailoring

Table 2-1 (Cont'd)

*DOCUMENT	DATE	TITLE	SOURCE
MSFC SPEC 522A	77 Nov 18	Design Guidelines for Controlling Stress Corrosion Cracking	SS-ELV-401
DAR 7.104.79(a) and (b)	1970 Sep	Safety Precautions for Ammunition and Explosives	General Provisions
DAR 7.104.81	1969 Jan	Accident Reporting and Investigations Involving Aircraft, Missiles and Space Launch Vehicles	General Provisions
DAR 7.104.98	1977 Oct	Hazardous Material Identification and Material Safety Data	General Provisions
AFSC DAR Sup 7-104.205	1982 Apr	Hazardous Materials Packaging Certificate of Equivalency	General Provisions
AF DAR Sup 7-5000.10	1982 Mar	Safety and Accident Prevention	General Provisions
AF DAR Sup 7-5000.15(a)	1979 Jul	Material Data Safety Sheet Submission	General Provisions

*Indicates specific tailoring

3.0 SCOPE

This ARAR is applicable to the T34D7 flight vehicle, support equipment and facilities.

3.1 System Identification

TBS

3.2 Support Systems

TBS

3.3 Operational Interfaces

TBS

3.4 Facilities

TBS

4.0 SAFETY CERTIFICATION

This section will be completed for the final draft in support of certification and is due 180 days prior to ILC.

4.1 ARAR's Completeness, Accuracy and Validity

TBS

4.2 System Compliance with Contractual Safety Requirements

TBS

4.3 Parameters for Safe Operation

TBS

4.4 Qualified System Safety Engineer Certificate

TBS

5.0 PROGRAM SAFETY STATUS SUMMARY

5.1 Safety Reviews

NOTE: Dates for future reviews are not firm.

5.1.1 Phase 0

The Phase 0 Safety Review was satisfactorily completed on 08Aug85 with two action items. See Table 5-1.

5.1.2 Phase 1 (IUS)

Scheduled for March 1986.

5.1.3 Phase 2 (IUS)

Scheduled for October 1986.

5.1.4 Phase 3 (IUS)

Scheduled for April 1988.

5.1.5 Phase 1 (Centaur)

Scheduled for April 1987.

5.1.6 Phase 2 (Centaur)

Scheduled for February 1988.

5.1.7 Phase 3 (Centaur)

Scheduled for August 1989.

5.2 System Safety Working Groups

System Safety Working Groups have been held as follows:

SSWG	DATE
1	25Apr85
2	08Aug85

See Table 5-1 for a listing of action items.

Table 5-1

Safety Review and Safety Working Group Action Items

DSN: T34D7.ITEMS.TEXT(1985) AWO: J122

T34D7 SAFETY OPEN ITEMS REPORT

ITEM No. DATE ASSIGN	ASSIGNED TO	LOC.	ACTION REQUIRED	SCHED.	PROM.	ACTUAL	STATUS/REMARKS
SSG1-1-CL 25APR85	LT M FOLSOM	SD	COORDINATE POTENTIAL PRIME CONTRACT SAFETY CHANGES (REF 9643-85-526)	TBD		OBE 08AUG85	SEE SRO-1
SSG1-2-CL 25APR85	R LOCKWOOD	SD	PREPARE SSG CHARTER FOR T34D7	15JUL85		08AUG85	SEE SSG2-1
SSG2-1 08AUG85	SSWG MEMBERS		COMMENT ON SSWG CHARTER (FOLLOW-UP FROM SSG1-2)	TBD			TO BE DISTRIBUTED BY R. LOCKWOOD, SD/SE
SRO-1-CL 08AUG85	A MAJOR	DEN	MMC TO INTEGRATE SPO, MMC, AEROSPACE, RANGE AND SE DESIRED CHANGES TO THE SOW AND CDRL AND PROVIDE DRAFT TO THE SPO FOR REVIEW AND PREPARATION OF AN APPROPRIATE RFP.	01SEP85	04SEP85	29AUG85	FOLLOW-UP TO SSG1-1 SLS-85-40086
SRO-2-CL 08AUG85	A MAJOR	DEN	MMC TO RESPOND TO ESMC CONCERN THAT MMA SAFETY ORGANIZATION CAN REQUIRE OTHER MMA FUNCTIONS TO RESPOND TO SAFETY; E.G.: SEM DISAGREES WITH STRESS ANALYSIS FOR NEW FORWARD OUTRIGGER ATTACH POINTS TO CORE VEHICLE (HYPOTHETICAL). ESMC WOULD LIKE TO SEE HOW THIS INTERFACE IS EFFECTED WITH ASSURANCE THAT THE SEM PROBLEM WOULD BE DISPOSITIONED.	01SEP85		28AUG85	SLS-85-40083

6.0 SAFETY NON-COMPLIANCE ITEMS

At this point in the program approximately 75 noncompliance items have been identified. This section will list them.

6.1 Waiver/Deviation Disposition

Of the 75 noncompliance items approximately 60 waiver/deviation requests will be submitted.

6.2 Supporting Documentation

TBS. To be furnished with waiver requests and included here when available.

7.0 GENERAL SYSTEM DESCRIPTION

Note: See ARAR annexes for detailed descriptions of Stage 0, I, II, liquid engines, upper stages, and payload fairing.

7.1 Primary System

7.1.1 System Overview

7.1.1.1 The T34D7 Complementary Expendable Launch Vehicle (CELV) consists of the major elements shown in Figure 7-1.

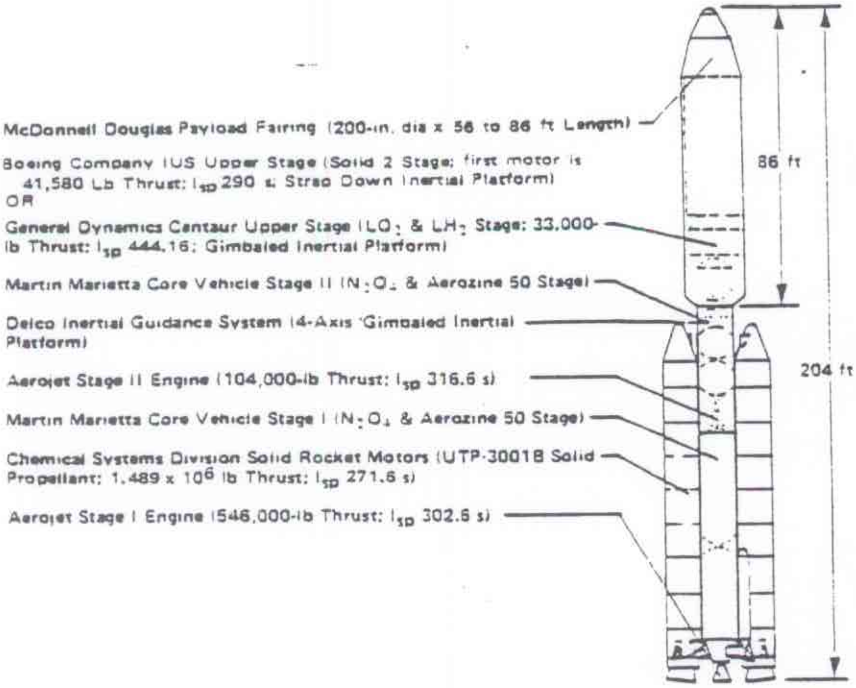
7.1.1.2 The design uses two 7-segment solid rocket motors (SRM) attached alongside a two-stage, liquid propellant core vehicle. Each SRM is 10 feet in diameter and contains 591,692 lbs of UTP-3001B propellant and delivers 1.489M lb maximum sea level thrust. Flight control is provided by a fluid-injection, thrust vector control system supplied from a side- mounted tank on each motor carrying 8,424 lb of N_2O_4. Eight staging rockets on each SRM assure positive separation.

7.1.1.3 Stage I of the 10 ft diameter core vehicle contains 341,000 lbs of N_2O_4/Aerozine 50 storable propellants. The dual-chamber, pump-fed, ATC LR-87-AJ-11 engine delivers 546,000 lbs vacuum thrust at a specific impulse of 302.6 seconds. Each chamber is gimbaled to provide three-axis vehicle control. Stage II contains 77,000 lbs of N_2O_4/Aerozine 50 and has one ATC LR-91-AJ-11 pump-fed engine delivering 104,000 lbs vacuum thrust at 316.6 seconds specific impulse. Gas generator exhaust passing through a swiveled nozzle provides roll control. Both Stages I and II tanks and structure are welded aluminum alloys. They both use autogenous pressurization systems with engine-heated propellant gases fed to the appropriate tank.

7.1.1.4 Guidance and flight control of Stages 0, I and II are provided by an inertial measurement unit (IMU) and missile guidance computer (MGC). These units are mounted on trusses at the forward end of Stage II with the battery power supply, telemetry and S-band transmitter. Stages 0 and I also use rate gyros, mounted on the bottom of the Stage I oxidizer tank, for pitch and yaw control.

7.1.1.5 The CELV missions are configured with either one of two upper stages: IUS or Centaur. The IUS vehicle is a two-stage solid propellant vehicle that delivers the spacecraft to extended earth orbits. The IUS baseline consists of a propulsion subsystem, an avionics subsystem, and associated structures and mechanisms.

7.1.1.6 The Centaur is a 14.2 ft diameter upper stage that contains 46,000 lbs of LO_2/LH_2 propellants in pressure stabilized stainless steel tanks. Two RL10A-3-3A engines provide 33,000 lb of vacuum thrust at a specified impulse of 444.16 seconds. Centaur G guidance, flight control and avionics are mounted on the outer skin of the forward adapter. Coast phase attitude control uses monopropellant hydrazine thrusters.



*REPRESENTS CENTAUR WEIGHT

Flight Element	Wt, lb	Reliability
SRMs	1,385,702	0.99749
Core Stage I	359,155	0.99385
Core Stage II	85,913	
Centaur or IUS	52,585 *	0.99(Allocated)
Payload Fairing	12,074	0.9999
Payload	10,000	N/A
Total	1,910,499	0.9813

CENTAUR
Performance - Payload Weight

GSO	— 10,565 lb
24-h Inclined	— 10,918 lb

Payload Accommodations

Payload Size: 15-ft by 40-ft Dynamic Envelope
Payload Weight: 10,000 lb (GSO); 11,500 lb (Inclined)
Payload Environments: ≤ STS
Payload Interfaces: Equivalent to STS

Figure 7-1 Complementary Expendable Launch Vehicle (Centaur Configuration)

7.1.1.7 A 200 inch diameter payload fairing (PLF), with a length of 56 ft for IUS and 66, 76, and 86 ft for Centaur encloses the upper stage and the payload. The fairing structure is aluminum isogrid. The fairing is jettisoned in three segments by ordnance initiated gas expansion bellows before Stage I burnout. The 86 foot fairing provides a usable payload compartment 15 ft in diameter by 40 ft long, equivalent to that of the Shuttle.

7.1.2 Booster Stage 0, Solid Rocket Motors (SRM)

7.1.2.1 Stage 0 consists of two identical 7-segment SRM's mounted 180 degrees apart on the core vehicle. Each SRM is 10 ft in diameter by 112.9 ft long and is loaded with 591,592 lbs of solid propellant. (See Figure 7-2.)

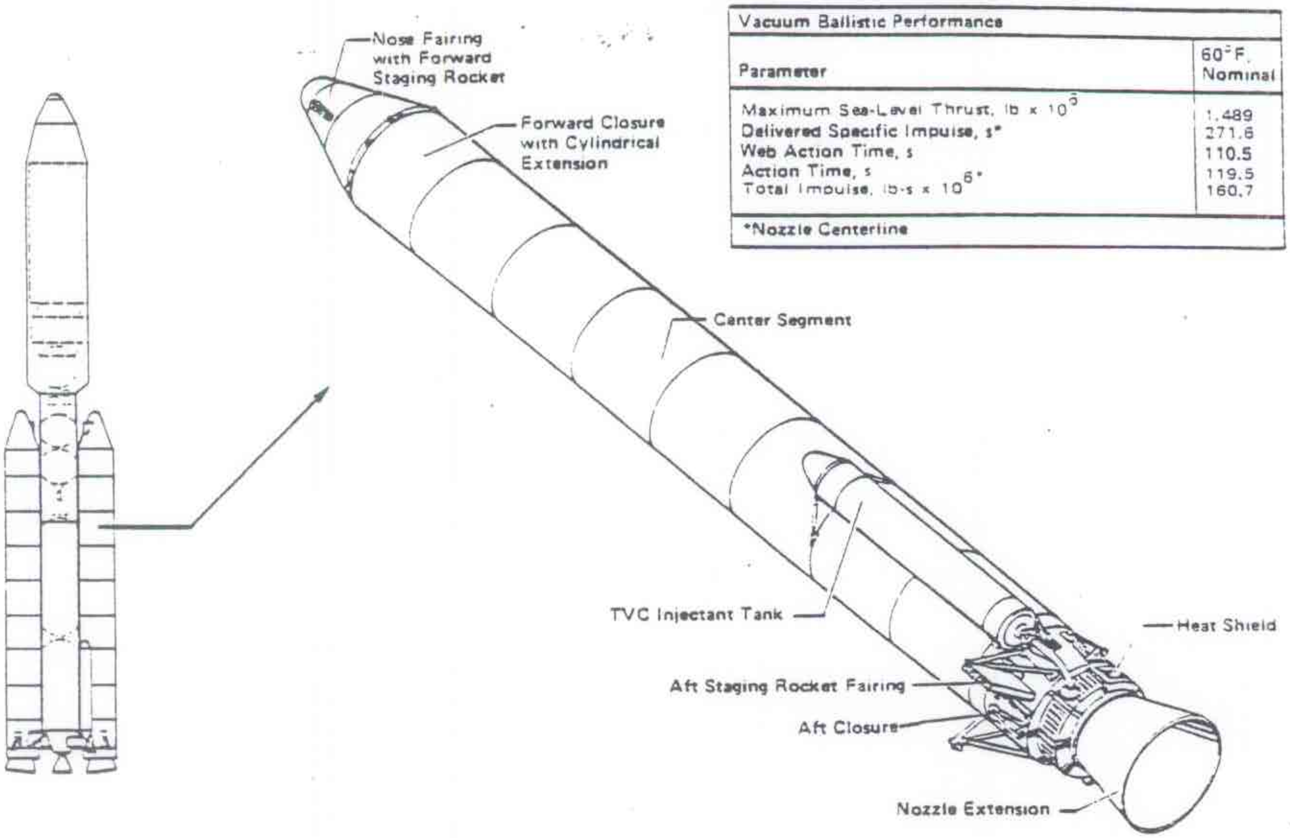
7.1.2.2 The SRM structure consists of 7 segments and a forward and aft closure. The motor segments are 120 inch diameter by 130 inch length and loaded with 73,000 lbs of solid propellant, UTP-3001B. The fore/aft closures and motor segments are made of D6AC steel.

7.1.2.3 Each SRM has a maximum sea-level thrust of 1.489×10^6 lb, an I_{sp} of 271.6 s, a web action time of 110.5 s, and a total impulse of 160.7×10^6 lb-s. The propellant (UTP-3001B) is PBAN-based and contains 84% solids (16% aluminum and 68% ammonium perchlorate, plus additives and an iron oxide catalyst).

SRM PERFORMANCE

Vacuum Ballistic Performance	
Parameter	60°F, Nominal
Maximum Sea-Level Thrust, lb x 10^6	1.489
Delivered Specific Impulse, s*	271.6
Web Action Time, s	110.5
Action Time, s	119.5
Total Impulse, lb-s x 10^6*	160.7

*Nozzle Centerline



MAJOR COMPONENTS

Component/ Assembly	Description	Flight Quantity	Previous Use	Modifications Required
Stage 0 Major Components				
Nose Section	Encloses Forward Staging Motors, Instrumentation, Electrical & Ordnance Cabling, & Umbilical Connectors	Two per Vehicle	T-III C, D, E, & 34D	None
Forward Closure	Forward Extension & Igniter Assembly	Two per Vehicle	T-III C, D, E, & 34D	40-in. Longer (MOL Design)
Motor Segment	130-in. Long by 120-in. dia	14 per Vehicle	T-III C, D, E, & 34D	Additional Insulation (Aft 3 Segments)
Aft Closure	Aft Closure & Throat Entrance	Two per Vehicle	T-III C, D, E, & 34D	Additional Aft Insulation
Nozzle Assembly	Throat, Exit Cone, & Extension	Two per Vehicle	MOL Tests	None
Aft Skirt	SRM & Core Support Hardware	Two per Vehicle	Modified	Modified 34D Design
Propellant	UTP-3001B	1.184×10^6 lb per Vehicle	MOL Tests	None
TVC System	Tank, Manifold, & Electro-motive Valves	Two per Vehicle	T-III C, D, E, & 34D	None
Electrical System	Instrumentation, Control, & Ordnance	Two per Vehicle	MOL Tests	None

Figure 7-2 Booster Stage O Rocket Motors

7.1.2.4 The thrust vector control consists of a nozzle assembly, TVC tank, valves and feed lines. The nozzle assemblies use a 10.03 to 1 expansion ratio and are canted 6 deg. Thrust vector control is provided by injection of liquid nitrogen tetroxide (N_2O_4) that is driven by a nitrogen pressurized ullage. The N_2O_4 injectant is pressure fed to 24 electromechanical valves mounted on each nozzle. The 24 valves inject N_2O_4 into the motor exhaust stream to produce vehicle steering.

7.1.2.5 The thrust vector control (TVC) tank is 42 inches in diameter and approximately 22 ft in length with a total tank weight of 3817 lbs. This is a single tank structure using an ullage blowdown system. The TVC tank has a nominal load of 8424 lbs of N_2O_4 and initial pressure of 1030 psia which reduces to a minimum of 450 psia at SRM burnout. A single feed line transfers the TVC injectant from the tank to the nozzle distribution manifold.

7.1.2.6 Ordnance items include an igniter with redundant safe & arm devices, four forward and four aft stage separation rockets, and inadvertent separation destruct system. Electrical subsystem provides batteries, electrical distribution boxes, power transfer switches, and power umbilicals. Instrumentation provides command and remote multiplex units.

7.1.3 Booster Vehicle Structure

7.1.3.1 The Stage I, II Booster vehicle is a 10 ft diameter by 119.1 ft long, two-stage liquid propellant vehicle. The primary structure consists of aluminum alloy barrel skins with stringers and ring frames. The T34D structure is used as the basic design with a 112 inch extension to accommodate additional propellant requirements.

7.1.3.2 The Stage I, II Booster vehicle is the basic building block because the two 7-segment SRM's strap on to the core, and the upper stage and PLF attach to the Stage II forward oxidizer skirt. In addition, the booster vehicle structure provides the tankage for the liquid rocket engines, provides trusses and mounting for avionics equipment.

7.1.3.3 An outboard profile of the Stage I, II Booster vehicle, including vehicle stations is provided in Figure 7-3. Stage I is 86.5 ft in total length, and composed of barrel skins with integrally machined stringers 280.6 inches long for the fuel tank and 326.0 inches long for the oxidizer tank. Each tank has welded vertical seams and welded closure domes. The aft end of the fuel tank is configured with a stiffened cone interfacing with the engine feed lines. Internal ring frames are used in both tanks. Four equally spaced external longerons on the fuel tank interface with the LRE and SRM structure systems.

7.1.3.4 Stage II is 32.6 ft long and similar to Stage I, except the barrel skin panels between tank structure (compartment 2B) is the location for the forward SRM attach fittings, four retrorockets, and support structure. Destruct charges and initiator are supported on two minitrusses in compartment 2B. The Stage II forward oxidizer skirt has two trusses to support the avionics system components. An

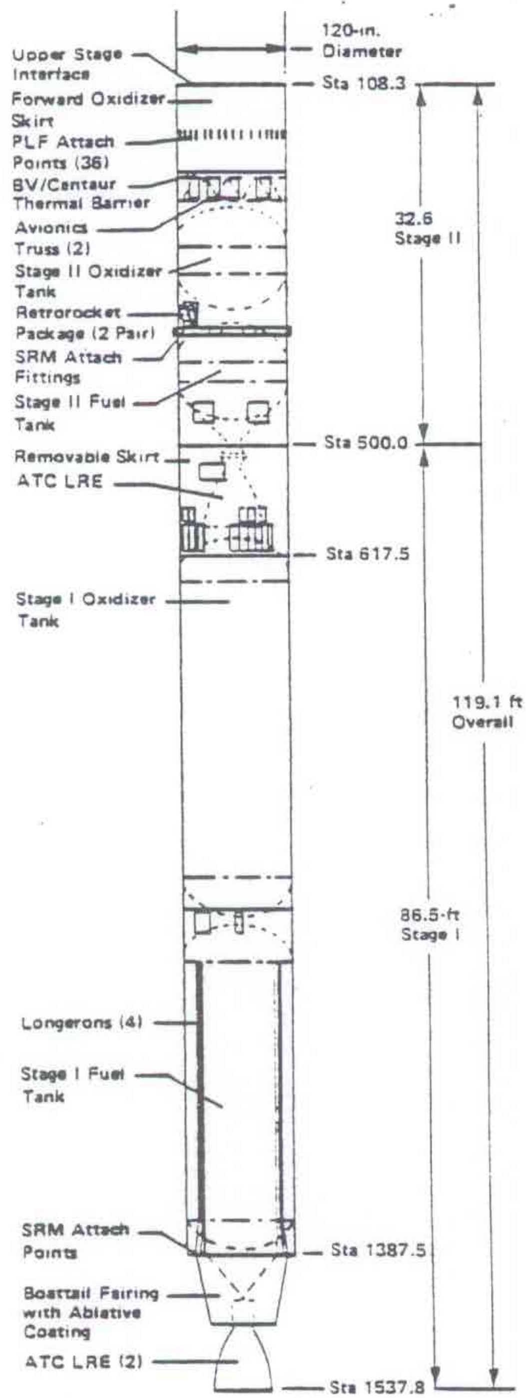


Figure 7-3 Booster Vehicle Structure

environmental control thermal barrier is located just above the 2A trusses for the Centaur configuration. Access is provided through the barrier to the engine bells and motor nozzles. The section of the skirt above the thermal barrier provides the structural interfaces for the PLF and the upper stages.

7.1.4 Booster Vehicle Propulsion Stage I, II

7.1.4.1 Stage I and II propulsion is provided by LR87-AJ-11 and LR91-AJ-11 engines developed by Aerojet Tech Systems Company. A proven design is used to reduce risks. The CELV design will use the T34D latest version of these engines and T34D stretched propellant tanks, i.e. 95 inch extension to stage I tanks and 17 inch extension to Stage II tanks. (See Figure 7-4)

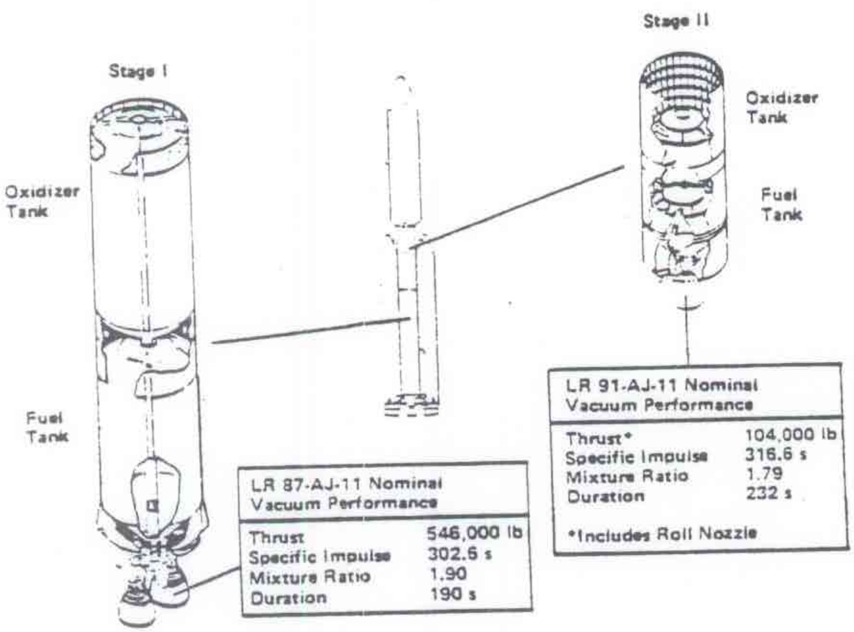
7.1.4.2 The booster liquid propulsion is provided by two tandem mounted liquid stages using storable, hypergolic propellants. The fuel is Aerozine 50 (50/50 blend of hydrazine and UDMH) and the oxidizer is N_2O_4. Stage I uses twin turbopump-fed engine subassemblies with 15 to 1 nozzle expansion ratios. Stage I nominal performance is 546,000 lb of thrust, an I_{sp} of 302.6 s, and a burn time of 190 s (341,000 lbs of propellants). Gas generators on each subassembly drive the engine turbopumps. A solid propellant start cartridge on each subassembly initiates pump operation. Thrust vector control (pitch, yaw, and roll) is provided by gimbaling the subassemblies. Stage II uses a single gimbaled turbopump-fed engine subassembly with a 49.2 to 1 expansion ratio nozzle. Stage II nominal performance is 104,000 lbs, an I_{sp} of 316.6 s and a burn time of 232 s (77,000 lbs of propellant). The stage II engine will be balanced to a thrust level 5% higher than the current Titan 34D engines. Roll control is provided by ducting turbine exhaust through a swiveled roll control nozzle.

7.1.4.3 Tank pressurization for both stages is provided by an autogenous (self generating) system and requires no transducers, valves, or active control systems. Both stages shut down upon propellant depletion or by guidance command. For the IUS configuration Stage I shutdown is by oxidizer depletion or by fuel level sensor. Except for the changes associated with the longer propellant tanks (longer oxidizer feedlines, longer pressurization lines) this is the same design used on the Titan III/34D programs (Figure 7-4).

7.1.5 Booster Vehicle Avionics

7.1.5.1 The booster vehicle avionics is an autonomous guidance, navigation, and control, electrical, and instrumentation system. It is a design that is derived from the T34D/Transtage. It provides adequate telemetry and meets the range safety requirements of AFETR 127-1. (See Figures 7-5 and 7-6)

7.1.5.2 CELV uses the Delco Systems IGS, consisting of a missile guidance computer (MGC) and a four axis gimbaled inertial measurement unit (IMU) to provide guidance, navigation, control, and sequencing of the



MAJOR COMPONENTS

Component/Assembly	Description	Flight Quantity	Previous Use	Modifications Required
Stage I – Engine Assembly	LR 87-AJ-11	1 Each	T-III B, C, D, E, & T34D	None
– Propellant Tanks	Fuel Tank 2132 ft^3 Oxidizer Tank 2543 ft^3			44 in. Longer 51 in. Longer
– Feed System	Prevalves, Accumulators, & Oxidizer Feedline	4 Prevalves 4 Accumulators 1 Oxid Feedline		Oxidizer Feedline 44 in. Longer Fuel Line + 44 in.; Oxid Line + 95 in.
– Pressurization System	Autongenous—Fuel & Oxidizer	1 Each		None
– Propellant	Fuel—A50 (UDMH/N_2H_4) Oxidizer—N_2O_4	118,000 lb 223,000 lb		
Stage II – Engine Assembly	LR 91-AJ-11	1 Each		5% Higher Thrust Balance
– Propellant Tanks	Fuel Tank 506 ft^3 Oxidizer Tank 564 ft^3			8 in. Longer 9 in. Longer
– Feed System	Prevalves & Oxidizer Feedline	2 Prevalves 1 Oxid Feedline		Oxidizer Feedline +17 in. Fuel Line + 8 in.; Oxid Line + 17 in.
– Pressurization System	Autogenous—Fuel & Oxidizer	1 Each		None
– Propellant	Fuel A50 (UDMH/N_2H_4) Oxidizer N_2O_4	27,700 lb 49,300 lb		

Figure 7-4 Stage I and II Propulsion

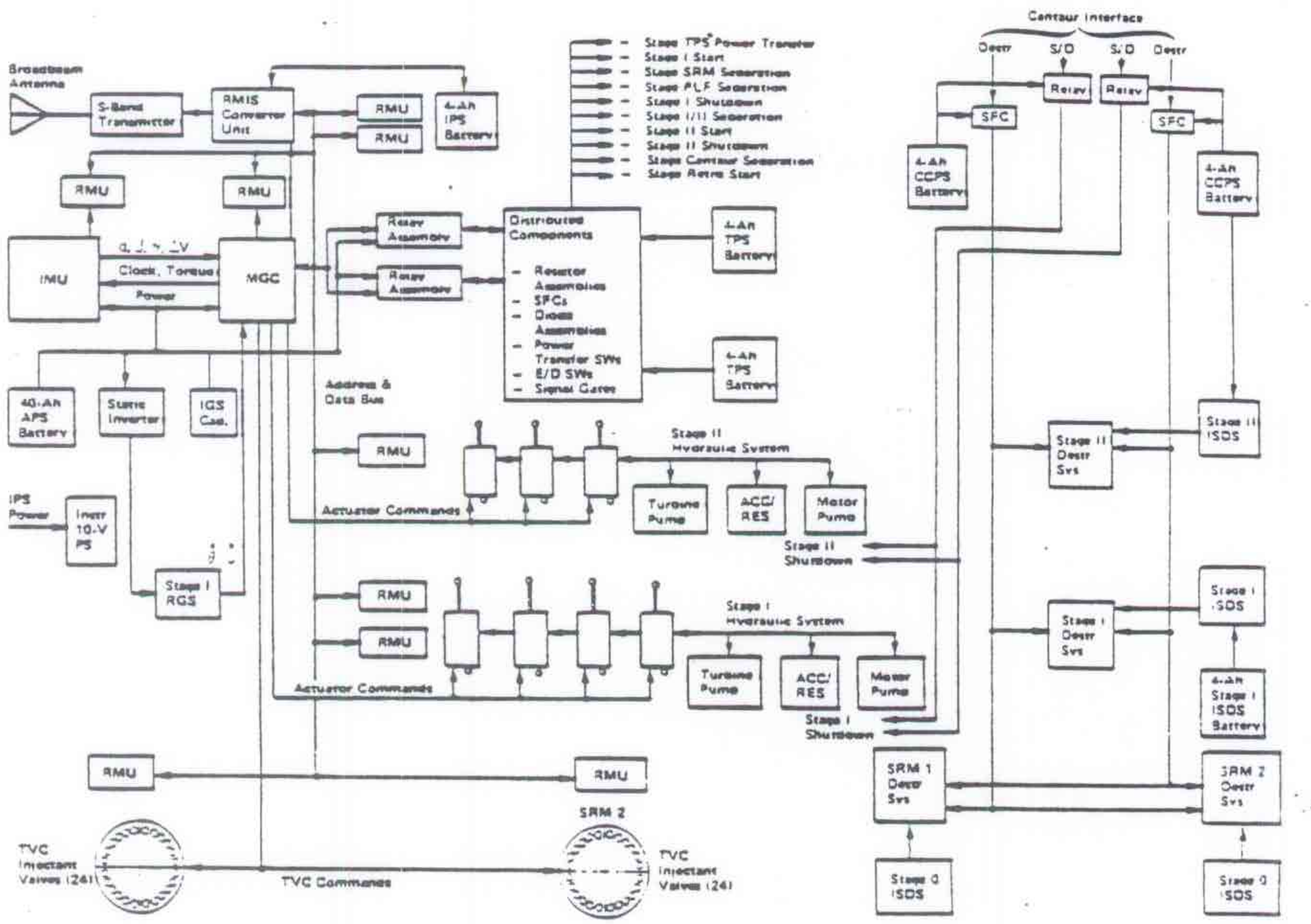


Figure 7-5 Booster Vehicle Avionics (Centaur)

Figure 7-5 T34D7/Centaur Avionics Configuration

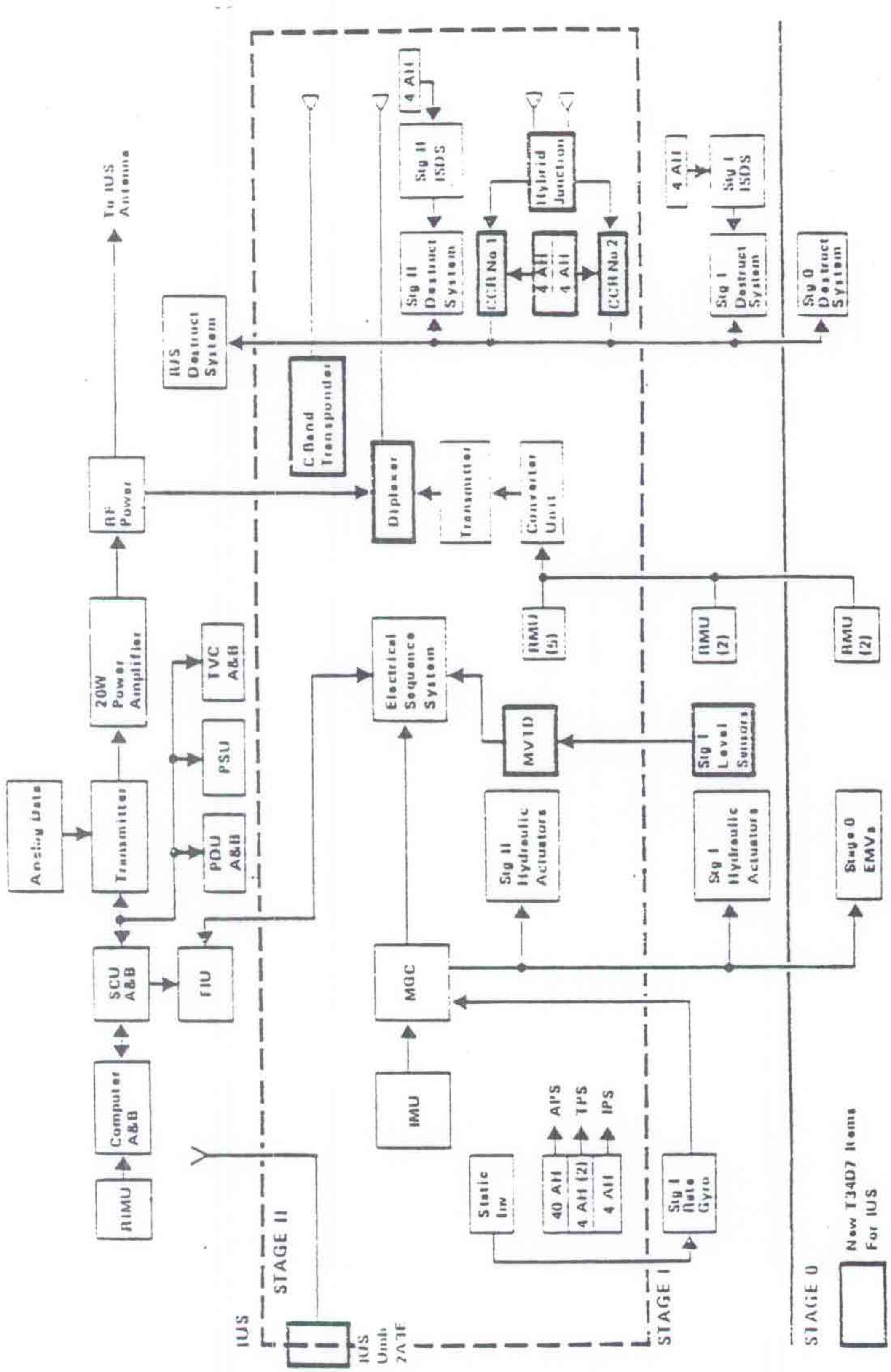


FIGURE 7-6 T34D7/IUS AVIONICS CONFIGURATION

Figure 7-6 T34D7/IUS Avionics Configuration booster independent of the upper stage. Electrical power is provided by silver-zinc primary batteries. The distributed sequencing system is a subset of the Transtage system using identical components, and electrical isolation is maintained between the booster and upper stage. The SCI remote multiplexed instrumentation system (RMIS) provides 384 kbps of booster telemetry to allow accurate analysis of all booster systems. The telemetry data are transmitted via a 10-W S-band transmitter and a single broadbeam antenna. The telemetry system is also completely independent of the upper stage.

7.1.5.3 CELV tracking is provided by a C-band pulse beacon in the upper stage for Centaur and in Stage II for IUS Configuration. Command control receivers in the upper stage for Centaur and Stage II for IUS provide shutdown and destruct commands to the vehicle. Inadvertent separation destruct systems are included in both core vehicle stages, the IUS and in each SRM. New T34D7 items for IUS configuration (Figure 7-6) are: C-band beacon, redundant command control receivers, an IUS umbilical (2A3E), C-band and CCR antennas, and Stage I low level sensor shutdown.

7.1.6 Booster Vehicle Software

7.1.6.1 The booster vehicle software is derived from the T34D/Transtage software by deleting Transtage unique functions and adding pitch and yaw bias equations. The CELV software will employ existing development methods and verification and validation testing tools.

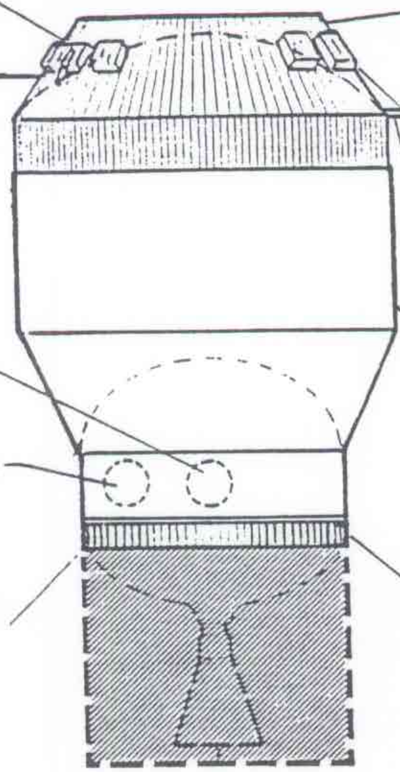
7.1.6.2 CELV design approach is the Titan "flex launch" concept that was proven with 14 flights using a single flight program version that flew five different mission peculiar parameters sets.

7.1.6.3 New aspects to the software include a technique adapted from the Titan IIIE program for tailoring the Stage 0 steering profile to the premeasured winds aloft; and derived body rates and accelerations from the core IMU data that permit the removal of the Stage II rate gyro and LASS equipment. These modifications provide pitch and yaw bias that enhances performance and alleviates aerodynamic loads. To provide safe margins of spare memory, and to accommodate any further requirements, all Transtage unique equations will be deleted. Deletion of transtage unique requirements will increase spare memory margins from 8 to 11%.

7.1.7 Centaur Upper Stage

7.1.7.1 The Centaur provides final velocity increment to achieve park orbit and to deliver spacecraft to extended earth orbits. The CELV Centaur uses the basic STS Centaur G Prime structure and propulsion, the STS Centaur G avionics, and tracking and range safety command equipment from the Centaur D-1A. (See Figure 7-7)

7.1.7.2 The CELV Centaur stage design is based on hardware and software developed for the Centaur G and G Prime vehicles. Figure 7-7 shows the CELV Centaur configuration with major subsystems and



NOTE: Items 1 thru 11 are G-Prime modifications for T34D7

Figure 7-7 Centaur Upper Stage

features identified. The stage is 29.3 ft long with a maximum diameter of 170 in. Dry weight of the stage is 6,120 lbs and loaded weight is 52,585 lbs.

7.1.7.3 The stage uses LO_2 and LH_2 cryogenic propellants with two Pratt and Whitney RL10A-3-3A engines delivering 16,500 lbs thrust, each with an I_{sp} of 444.16 s. The pressure stabilized tanks are of welded high strength stainless steel construction with propellant capacity of approximately 46,000 lbs. The hydrazine reaction control system (RCS) consists of 12 6-lb thrust units and two positive expulsion tanks with 340 lb hydrazine capacity.

7.1.7.4 The basic structure and tanks are from the G Prime. The forward adapter includes a forward bearing reactor system and provides the three payload interface mechanical attachments. The Centaur is attached to the CELV core through an the aft adapter.

7.1.7.5 The CELV Centaur uses the DOD STS Centaur G avionics with minor changes to meet range and DOD functional requirements. The avionics include electrical power, guidance, navigation, control, instrumentation, secure telemetry, tracking, and range safety command destruct subsystems.

7.1.8 Inertial Upper Stage (IUS)

7.1.8.1 The IUS in conjunction with the CELV will deliver spacecraft to extended earth orbits. The baseline design is a two stage vehicle, which can tailor the weight of solid and liquid propellants for specific DOD missions. The IUS baseline consists of a propulsion subsystem, avionics, and associated structures and mechanisms. The IUS has previously flown on T34D and STS missions. (See Figure 7-8)

7.1.8.2 The propulsion subsystem of the IUS consists of two solid rocket motors (SRMs), thrust vector control (TVC) subsystem, and a reaction control subsystem (RCS). The 2 SRMs contain a maximum of 27,400 lbs of Class I, Division 3 propellant (AFR 127-100), consisting of ammonium perchlorate (68%), aluminum (18%), and hydroxy terminated polybutadiene (14%). The RCS consists of 1 to 3 titanium tanks and associated control valves and piping to the thrusters. Each tank nominally contains 122 lbs of hydrazine (N_2H_4), pressurized by 380 psi nitrogen (GN_2) over an expulsion bladder. Each tank is isolated by an ordnance-actuated valve from the feed system manifold piping. RCS thruster operation is controlled by the IUS computer.

7.1.8.3 The avionics subsystem includes the following: guidance, navigation, control, data management, telemetry, and electrical power including the vehicle batteries.

7.1.8.4 The IUS structures include Stage I and II assemblies, an equipment support structure, interstage structure and aft skirt structure. The mechanisms include staging equipment and mechanical elements.

7.1.8.5 The IUS vehicle functions include: solid rocket propulsion; flight control; guidance and navigation; telemetry; instrumentation; data management; onboard computation; electrical power and distribution.

7.1.9 Payload Fairing (PLF)

7.1.9.1 The PLF for the Centaur Configuration can accommodate a payload size equivalent to the cargo bay of the STS, 15 ft diameter by 40 ft length. The PLF is 200 inch diameter with a length of 55 ft for IUS and 66, 76, or 86 ft for Centaur and weighs 13,350 lbs at maximum length. (See Figure 7-9)

7.1.9.2 The PLF is a trisector design that consists of two primary sections (upper stage and payload compartments) a biconic nose, and a contamination free thrusting joint separation system (Figure 7-9). The PLF is designed to jettison in full length trisectors to assure proper clearances. The structure is all metal with an isogrid skin constructed of 7075-T7351 aluminum plate. Field joints are provided in the payload compartment to accommodate variable lengths of 10, 20, 30, and 40 ft. Separation energy is provided by a three strand Primaline ordnance charge. Nose cone external insulation reduces aerodynamic heating during ascent, and internal acoustic blankets limit acoustic levels to 139.3 dB (overall).

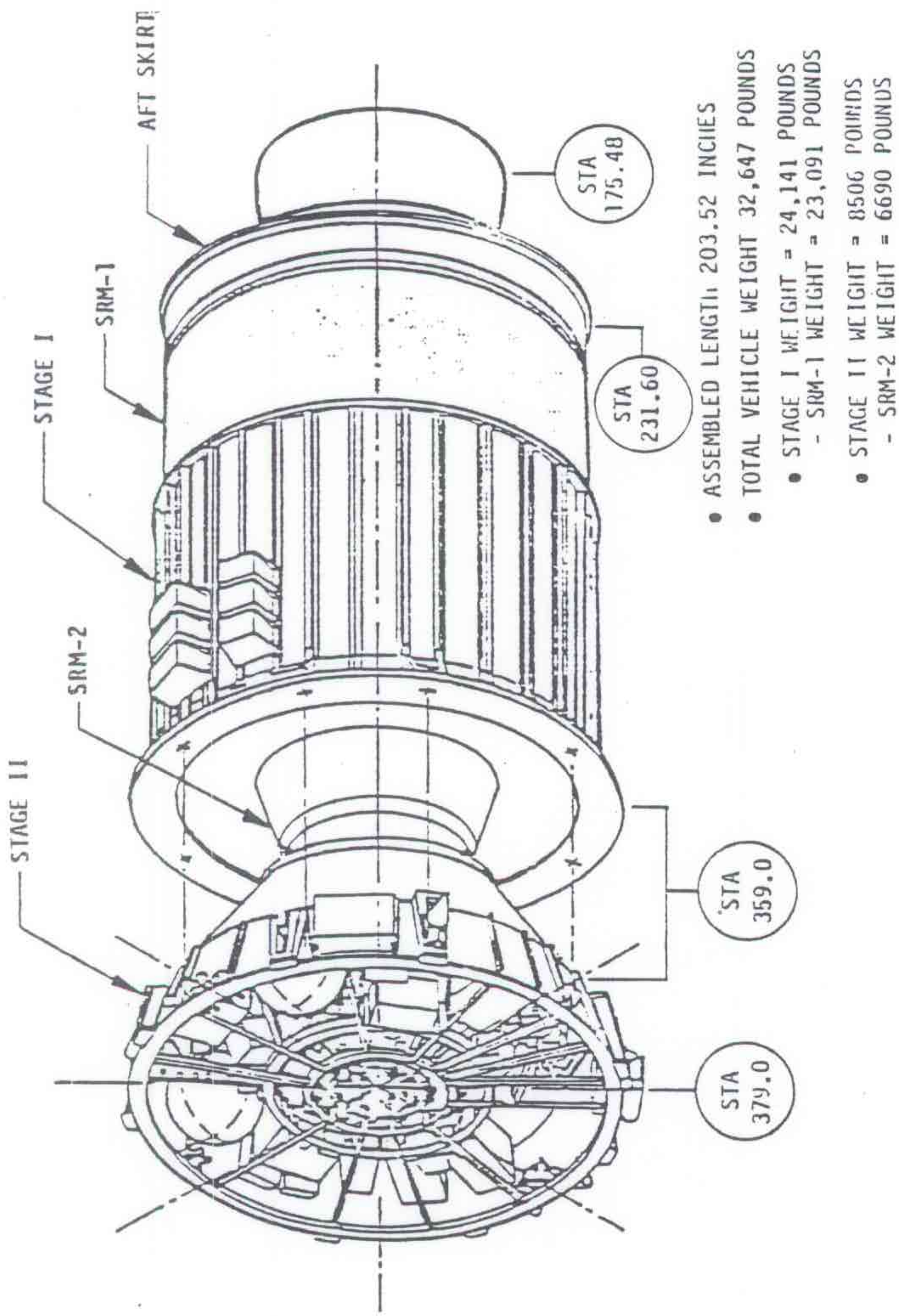


Figure 7-8 IUS Upper Stage

Figure 7-8 IUS Upper Stage

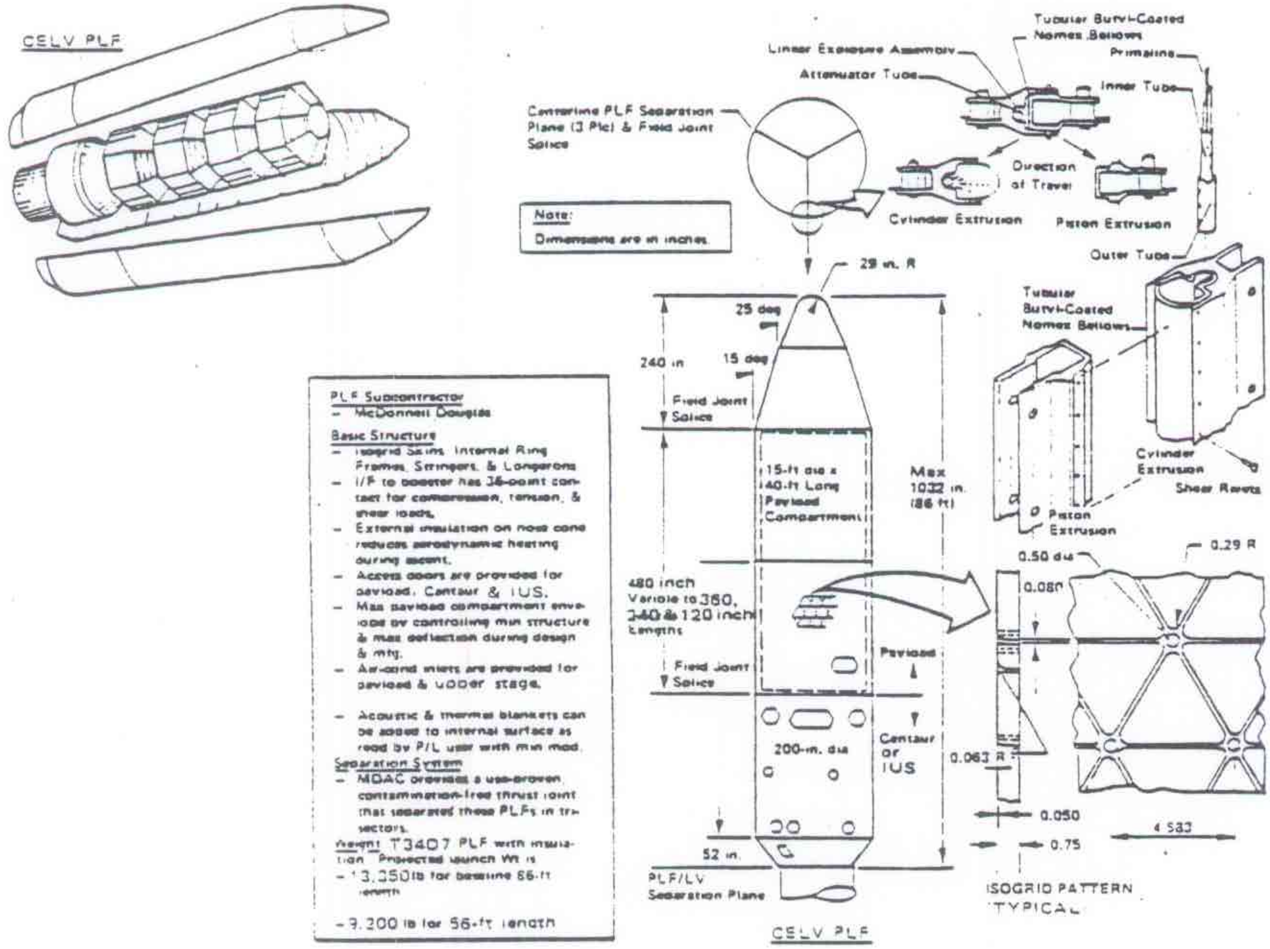


Figure 7-9 Payload Fairing (PLF)

7.2 Support System

7.2.1 Launch Complex

The CELV will use the existing Titan Integrate-Transfer-Launch (ITL) complex at CCAFS, including Launch Complex 41 (LC-41). Stages I, II and the Centaur upper stage will be processed in the Vertical Integration Building (VIB). The IUS will be processed through the SMAB east bay and mated to the booster at LC-41.

7.2.2 Structural and Handling

A Titan III launch transporter with vans will be used for Stage 0, I and II integration and transport to the launch pad. A support transporter will be used to bring the Centaur upper stage and aft payload fairing to LC-41 for erection onto Stage II. The umbilical tower and the mobile service tower will be refurbished and modified to handle the increased length and weights and launch overpressure of the CELV.

7.2.3 Aerospace Ground Equipment (AGE)

The electrical and mechanical AGE for the CELV is composed of the Titan 34D AGE and Centaur and IUS AGE. Minimum modifications will be needed to accommodate unique CELV requirements and to achieve an integrated system.

7.2.4 Safety Review and Criteria

Launch site facility design specifications; design drawings for AGE and pad conversion, modification, and refurbishment; and design changes will undergo T34D7 System Safety review and assessment. The review will assure compliance with federal, state, and/or AFOSH regulations. Design reviews will be supported to assure safety design criteria is incorporated into facility/support equipment specifications. Safety-critical maintenance procedures for facilities will also be reviewed and assessed.

7.3 Hazardous Subsystems

7.3.1 T34D7 Hazard Identification

Potential hazards associated with the design and operations of the T34D7 launch vehicle are listed below:

HAZARD	SOURCE
- Fire and Explosion	Fuels (liquid and solids)
- Pressure	Pneumatics, Hydraulics
- Structural Failure	Structures, Pressure Systems, Mechanisms
- Electrical/Electronics	Power Systems, Electronics, Batteries
- Collision	Transport, Material Handling
- Detonations	Ordnance
- Toxics/Asphyxiants	Propellants, Solvents, GN_2
- Corrosion	Propellants, Environments
- Stress	Materials, Loads
- Acceleration	Transport, Material Handling
- Shock (Mechanical)	Ordnance, Material Handling
- Human Factors	Operating Errors

7.3.2 Hazardous Materials and Components

The hazardous materials and quantities listed below reflect the levels of exposure during T34D7 operations.

- Stage 0 7-Segment Solid Rocket Motors
  - Solid propellant (Class 1, Div 3) 591,692 lbs per SRM
  - N_2O_4 liquid injectant 8,424 lbs per SRM

- Stage I and II Liquid Propulsion

Propellants:	Stage I:	Stage II:
Fuel (A-50)	118,000 lbs	27,700 lbs
Oxidizer (N_2O_4)	223,000 lbs	49,300 lbs

- Inertial Upper Stage (Class II Solid Propellant)
  Large motor Stage 1, (max load) - 21,400 lbs
  (min load) - 15,500 lbs
  Small motor Stage 2, (max load) - 6,000 lbs
  (min load) - 4,300 lbs

- IUS Attitude Control System
  Three tanks with 78 lbs each - hydrazine = 234 lbs pressurized to 380 psi nitrogen

- Centaur Upper Stage
  LH_2 fuel - 7,700 Lbs
  LO_2 oxidizer - 37,800 Lbs

- Centaur Attitude Control System
  Two tanks - 291 lbs hydrazine

- Electrical Power System
  Batteries (NiCd)

- Ordnance System
  EED's; retromotors; engine start cartridges; separation nuts; IUS/Centaur separation charge; engine exit closures (linear shape-charge); flight termination systems.

- Hydraulic Fluid

- Manufacturing Associated (solvents, paints, alcohol, etc.)

7.3.3 Safety Critical Design

System design has been identified that is considered safety critical for the risk assessment of the T34D7 missions operations.

- Handling equipment: Transportation, lifting, or rotation of vehicle stages or major assemblies; mating/demating of stages, spacecraft or payloads.

- Stage I, II liquid propulsion system: A-50 and N_2O_4 propellants; propellant tanks and system leak checks; propellant loading or off-loading; system activation; post-firing system safing; refurbishment; propellant system draining and propellant system filter change-out.

- Pressurization system: System leak checks; loading or off-loading pressurant; propellant tank pressurization control; post-launch safing and refurbishment.

- Ordnance: Handling, transporting, installing, or removing ordnance devices; connecting or disconnecting ordnance devices; checkout of ordnance devices for engine-start cartridges, retro-motors, staging explosive bolts; solid rocket motors and vehicle destruct.

- Electrical power: Handling, installing, connecting, and activating flight batteries; connecting and power-up or power-down of ground or launch vehicle power supplies.

- Data management: Control of safety critical functions by computer-issued discretes to sequence systems during vehicle checkout and launch.

- Structural interfaces: Launch vehicle/upperstage/payload/payload fairing attachments; staging or spacecraft separation provisioning.

7.3.4 Safety Critical Operations

T34D7 operations have been identified that require special attention due to hazard potential.

- Over the road transportation
- Handling and/or transporting the launch vehicle in a vertical position (i.e., transporting T34D7 to launch pad).
- Propellant transfer
- Propellant offloading
- Ordnance installation and checkout
- SRM stacking and assembly
- SRM handling and transport
- Engine cleaning with hazardous fluids
- Battery handling and installation
- Vehicle mating/demating operations
- System tests/checkout with propellants, pressurants and/or ordnance devices on board the launch vehicle.
- Pressure vessel system operations.
- Personnel working above a loaded tank and personnel working near suspended loads.
- Payload erection.
- PLF assembly and erection.
- Railroad operations.

8.0 INTEGRATED GROUND OPERATIONS

8.1 Facilities Description

The launch site facilities to be used for T34D7 are shown in Figure 8-1 through 8-5.

8.2 Processing

Processing of the T34D7 elements will take place as shown in Figure 8-6.

8.3 Flow Chart

TBS

Figure 8-1

Launch Complex 41

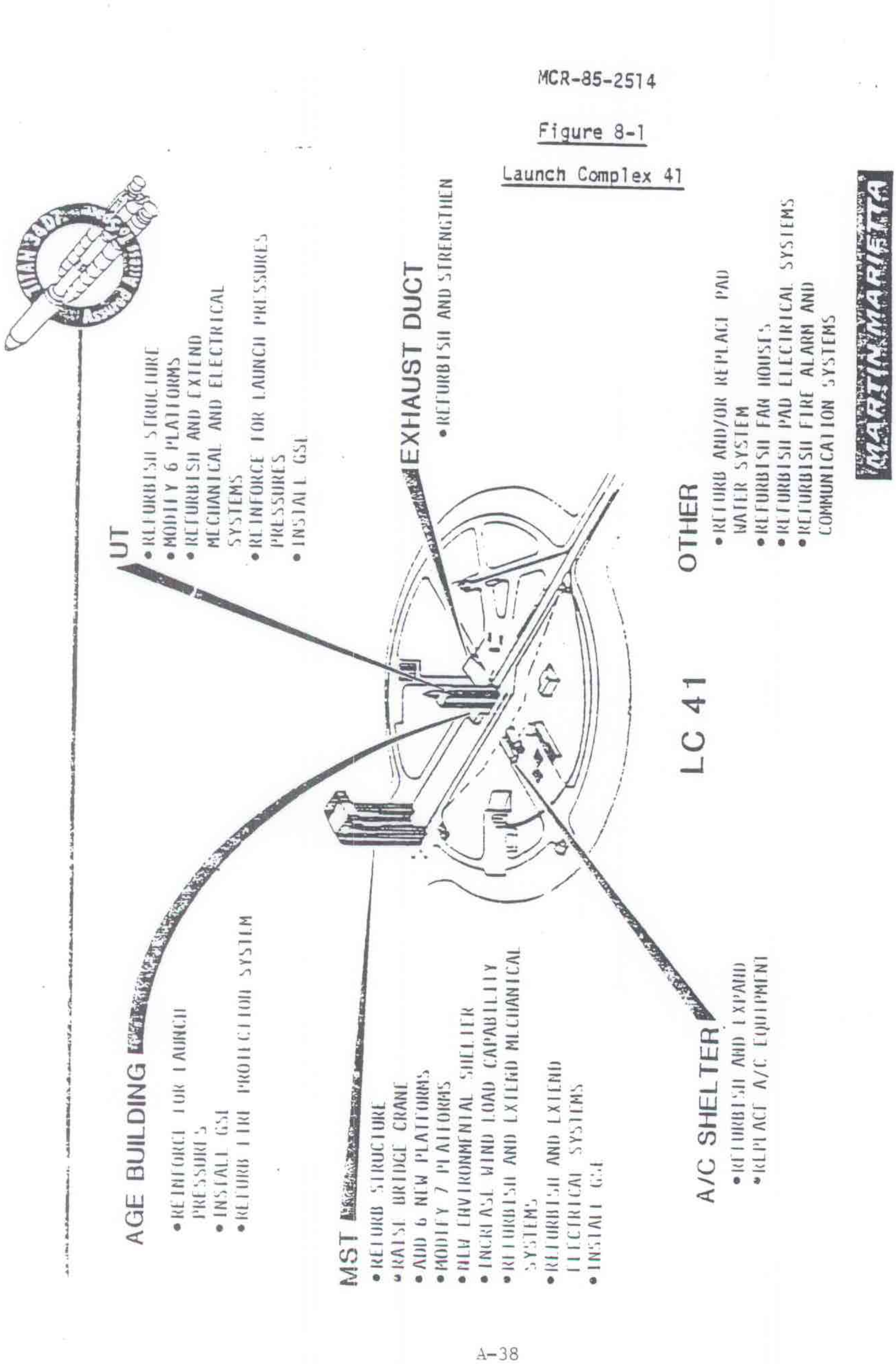


Figure 8-2

Solid Motor Assembly Building

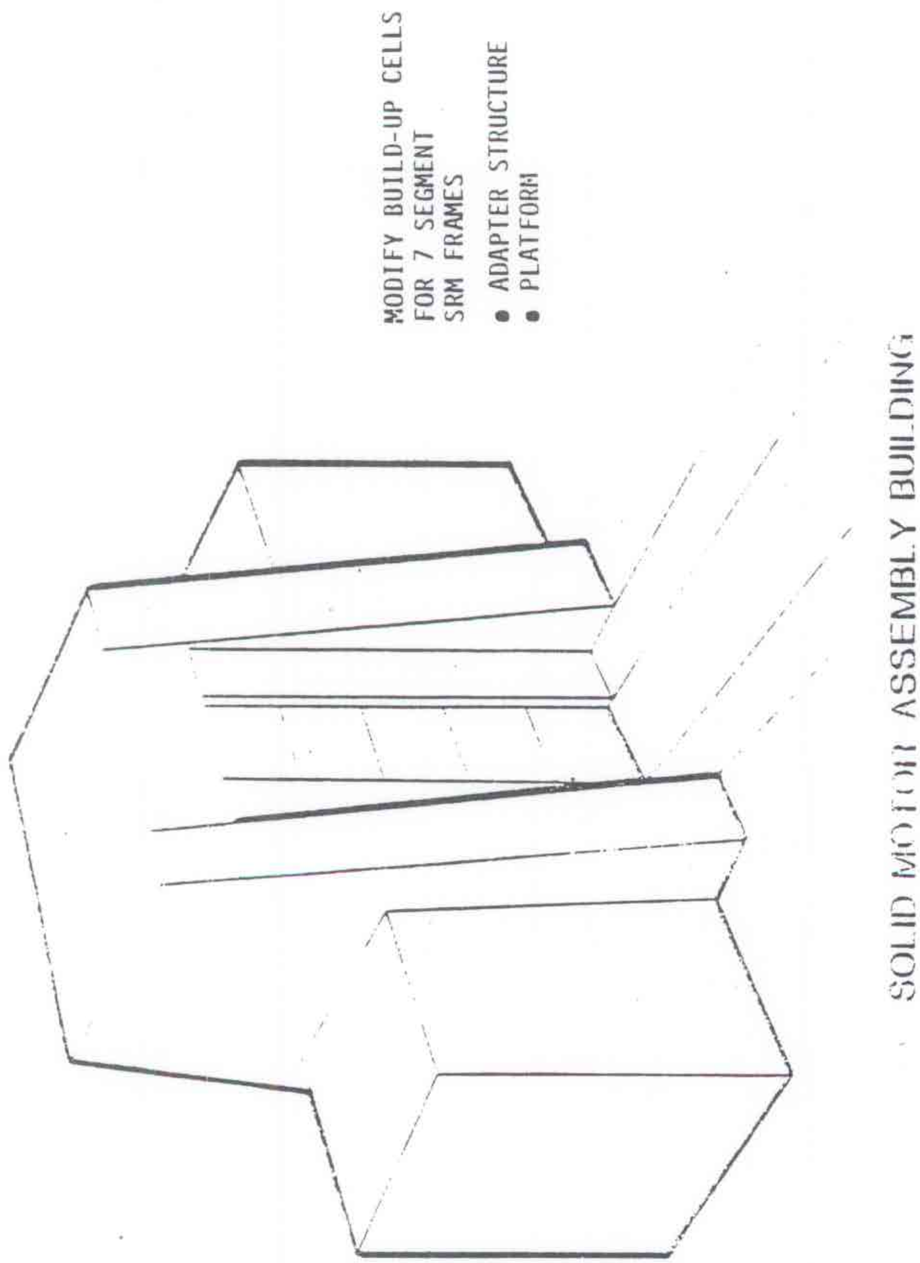


Figure 8-3

Vertical Integration Building

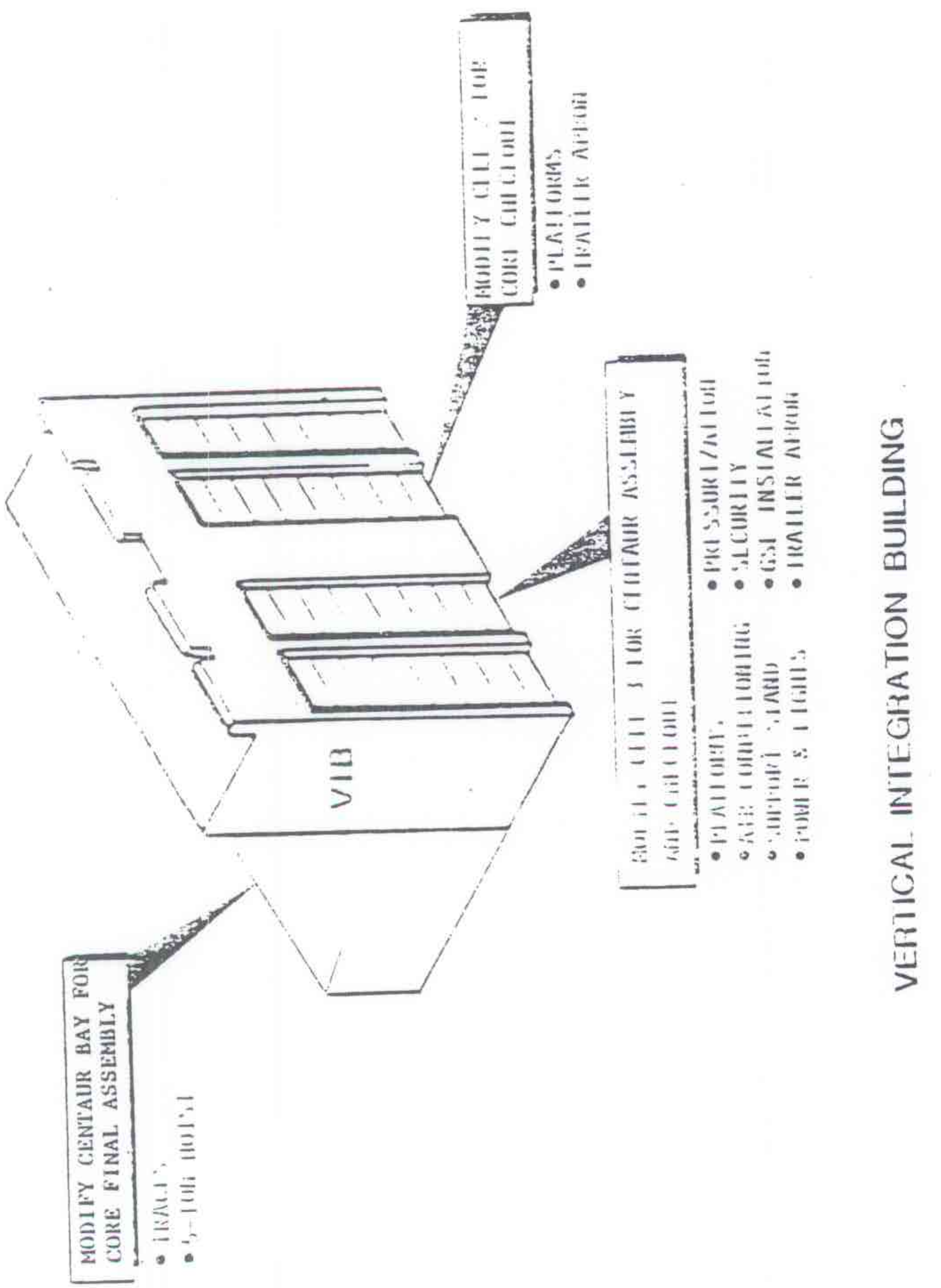


Figure 8-4

Motor Inert Storage Building

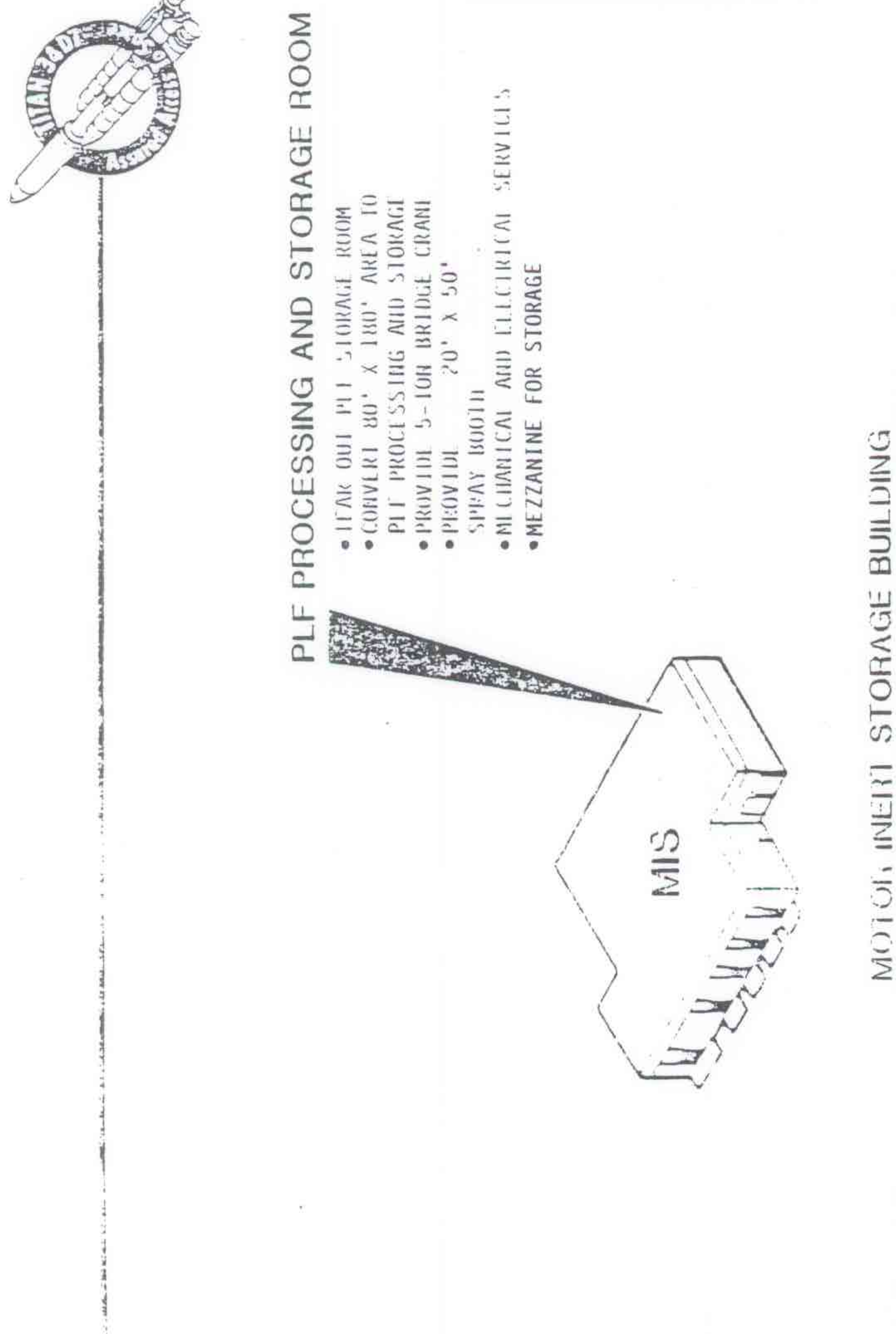


Figure 8-5

MST Engironmental Shelter

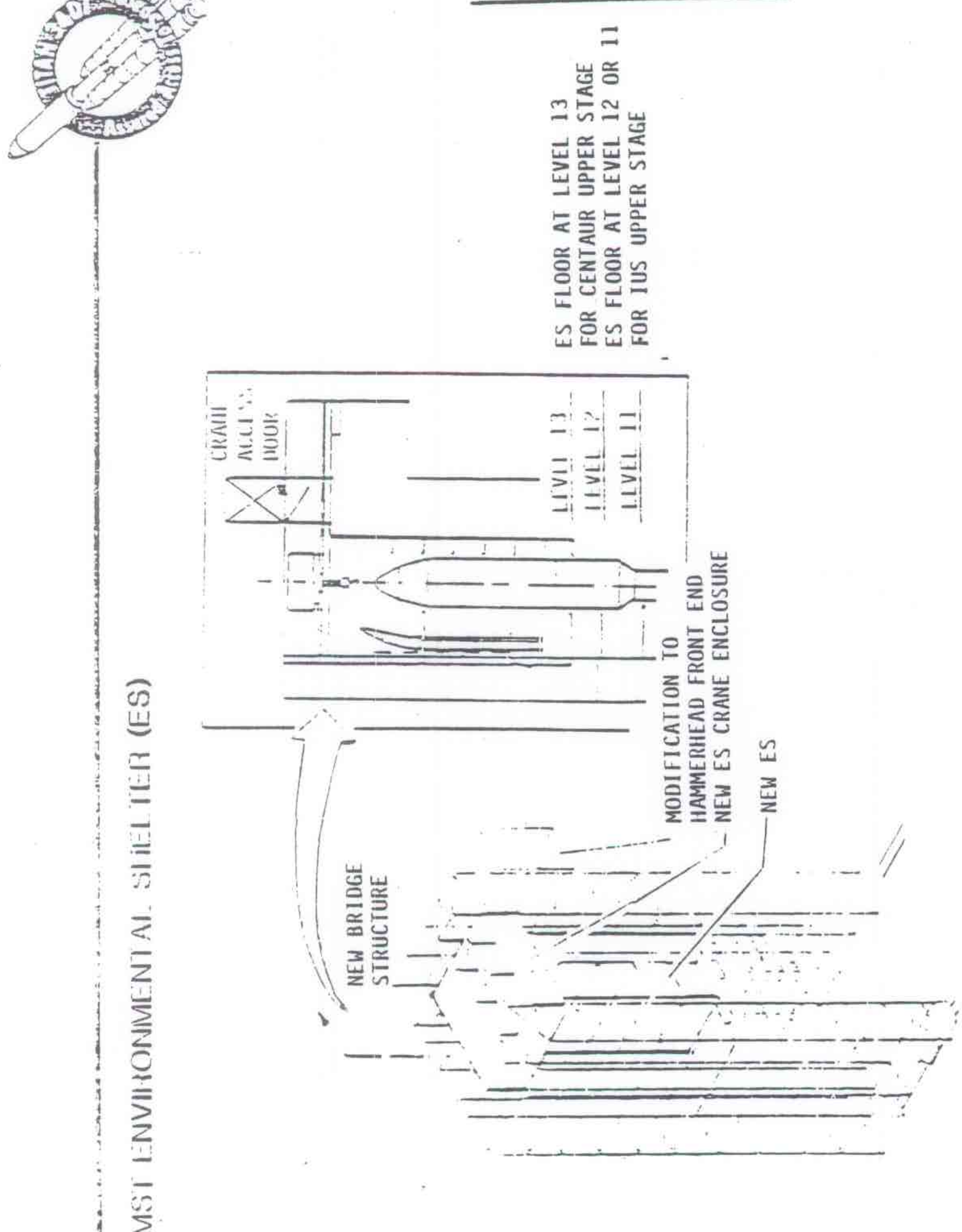
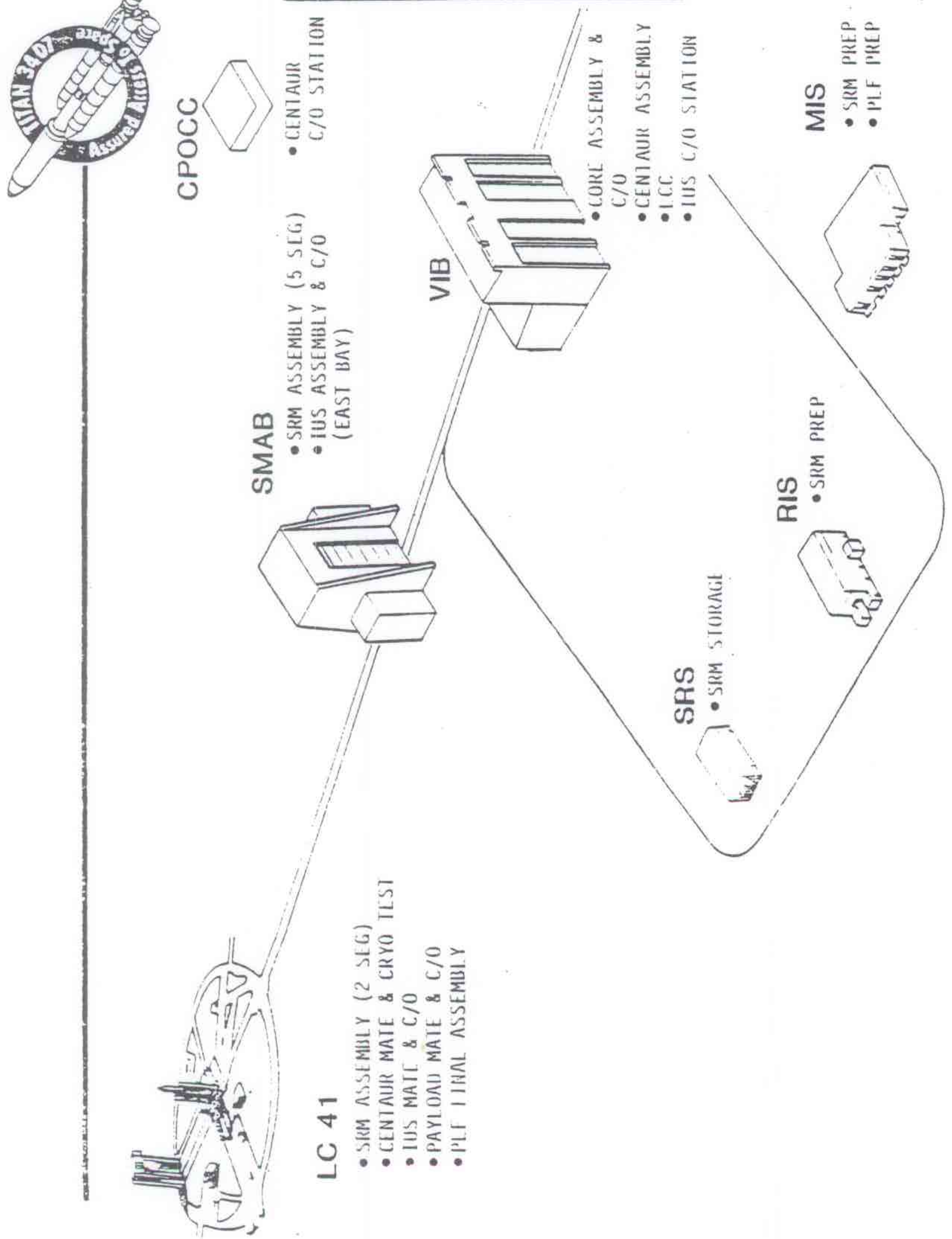


Figure 8-6

Integrate-Transfer-Launch Facility



9.0 FLIGHT OPERATIONS

Flight operations safety analysis will be delivered in CDRLs 016A2, 028A2, and 030A2. This section will not duplicate that data, but only summarize the results of the analysis.

9.1 Sequence of Events

See Figure 9-1 for typical Centaur mission and Figure 9-2 for typical IUS mission.

Figure 9-1 Typical Centaur Flight Sequence

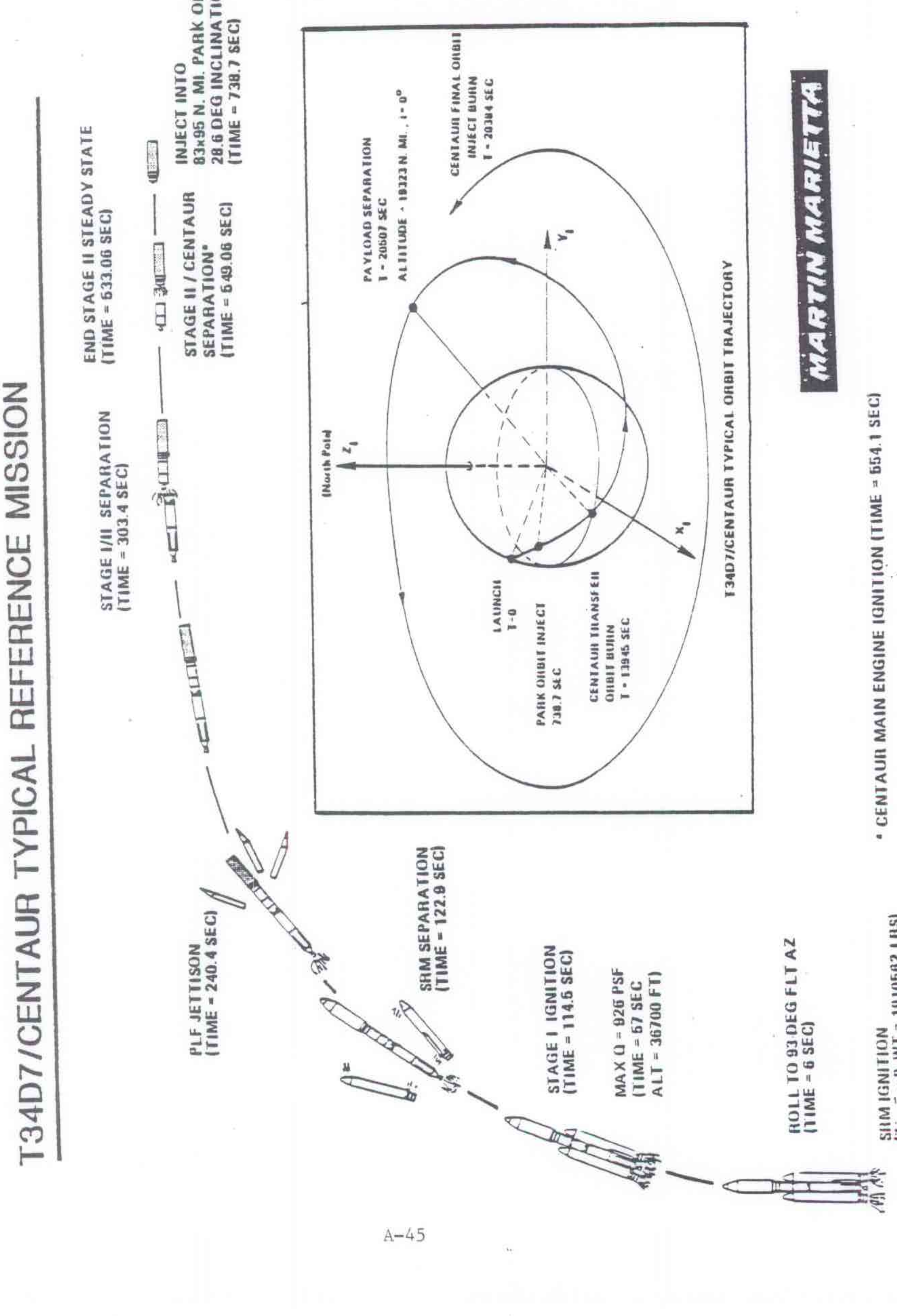
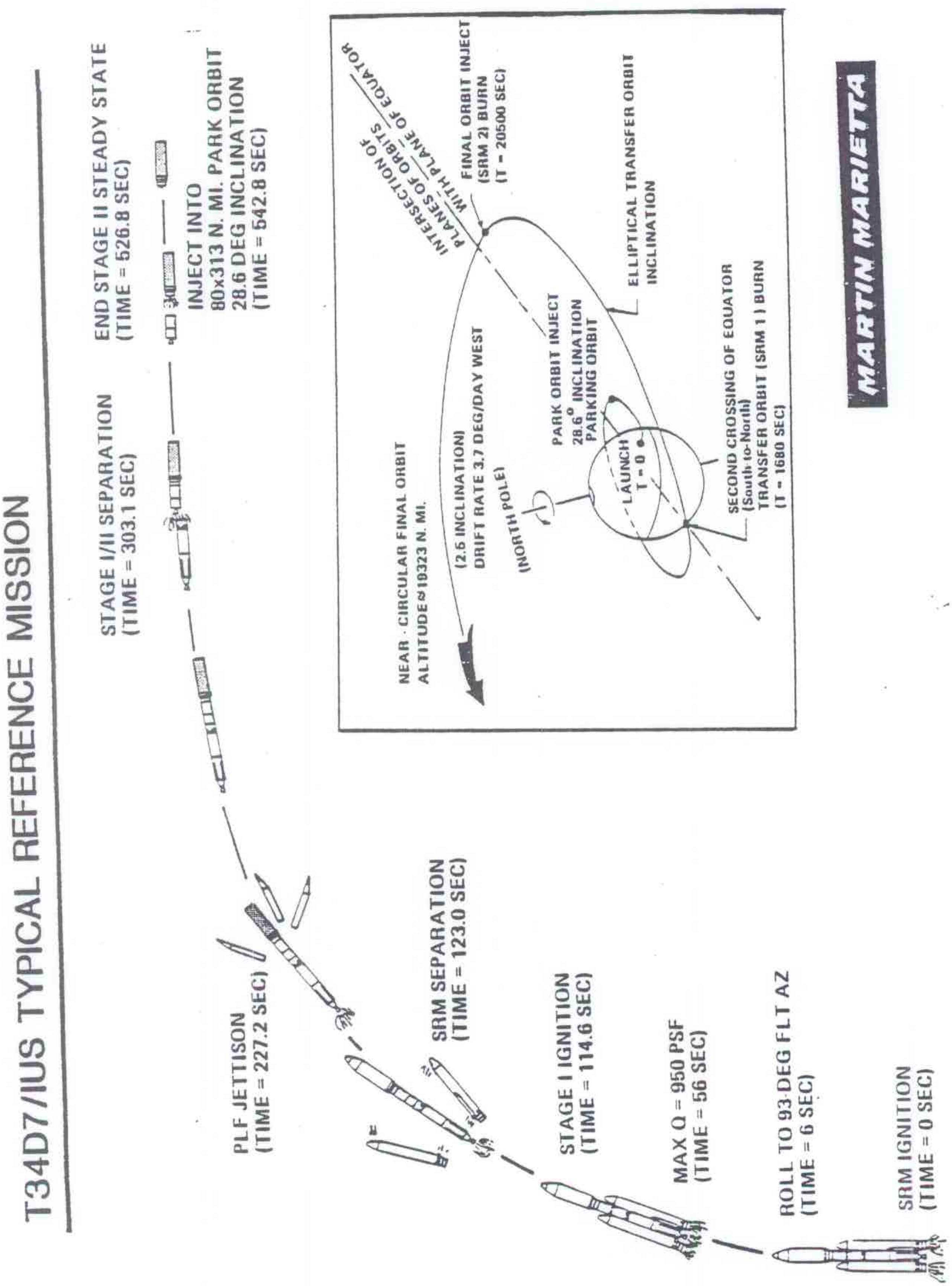


Figure 9-2 Typical IUS Flight Sequence



10.0 RISK ASSESSMENT

Throughout the course of T34D7 risk assessment, basic groundrules have been established. Operational phases were defined as shown in Figure 10-1; unacceptable conditions were defined as shown in Figure 10-2; and they were cross correlated as shown in Figure 10-3. As a result, a preliminary hazard analysis was completed as shown in Figure 10-4.

10.1 Integrated Analysis Summary

TBS - The form shown in Figure 10-5 will be used to document the results of the analysis.

10.2 Integrated Checklist

Integrated checklists will be provided for AFETRM 127-1 and MIL-STD-1574A.

10.3 Risk Summary

TBS

Figure 10-1

T34D7 Operational Phases

Analysis shall clearly indicate the applicable operational phases as follows:

NUM	PHASE	START	END
(0)	Launch Site Activation	Safety Assessment	Site Launch Ready
(1)	Subsystem Manufacture	Material Receipt	Subsystem Test Start
(2)	Subsystem Tests, (Qual., Acceptance, etc)	Subsystem Test Start	Pack & Load Complete
(3)	Transportation	Pack & Load Complete	Arrival CCAFS
(4)	Element Assembly	Arrival CCAFS	Element Test Start
(5)	Element Test	Element Test Start	System Assembly Start
(6)	System Integration	System Assembly Start	System Test Start
(7)	System Test	System Test Start	Prelaunch Servicing Start
(8)	Prelaunch Servicing	Prelaunch Servicing Start	Countdown Start
(9)	Countdown	Countdown Start	Launch
(10)	Flight Phase 1 (Park Orbit)	Launch	Arrive Park Orbit
(11)	Flight Phase 2 (Final Orbit)	Arrive Park Orbit	Arrive Final Orbit
(12)	Payload Separation	Arrive Final Orbit	Payload Separation

Figure 10-2

T3407 Unacceptable Conditions

CATEGORY/CONDITION	HAZARDOUS EVENT	SAMPLE HAZARDS
A. Impact/Collision	Physical Damage to Element or Subsystem (Kinetic Energy)	Impact during ground handling. Collision during transportation. Element recontact after separation.
B. Mechanical/ Structural Distress	Structural/Mechanical Failure	Container pressurization rupture/implosion Mechanical failure under load (stress corrosion, vibration or temperature inducted).
C. Fire/Explosion	Element/Subsystem Damage or Major Injury or Death of Personnel	Ordnance fire/explosion during assembly Propellant/oxidizer fire/ explosion during servicing or detanking Stage fire/explosion
D. Electrical Shock/ Discharge	Element/Subsystem/ Component Damage or Major Injury or Death	Shock/burns to personnel Electrical System Failure
E. Radiation/EMI	Element/Subsystem/ Component Damage or Major Injury or Death	Excessive radiation dose to personnel Electrical system interferance or damage
F. Contaminants/ Toxics/Debris	Element/Subsystem/ Component Damage or Major Injury or Death	Toxic release during processing Fuel/oxidizer supply interrupted Debris lodges in mechanical device or shorts electronics
G. Vehicle Off-Course (Other unacceptable conditions do not apply)	System Loss	Vehicle position requires destruct

Figure 10-3 Processing Phase vs Unacceptable Conditions

T34D7 PROCESSING PHASE VS UNACCEPTABLE CONDITIONS

CATEGORY/CONDITION

PROCESSING PHASE	A. Impact/ Collision	B. Mechanical/ Structural	C. *Fire/ Explosion	D. Electrical Shock/ Discharge	E. Radiation EMI	F. Contamin-ates/ Toxics/ Debris	G. Vehicle Off-Course Other un-acceptable conditions do not apply
(0) Launch Site Activation	X	X	X	X	X	X	
(1) Subsystem Manufacture	X	X		X		X	
(2) Subsystem Test; Qualifica-tion, Acceptance, Etc.		X		X		X	
(3) Transportation	X	X	X				
(4) Element Assembly	X					X	
(5) Element Test		X		X	X	X	
(6) System Integration	X		X			X	
(7) System Test		X	X	X	X	X	
(8) Prelaunch Servicing	X	X	X			X	
(9) Countdown	X		X	X	X		
(10) Flight Phase 1 (Park Orbit)	X	X	X	X	X	X	X
(11) Flight Phase 2 (Final Orbit)	X	X	X	X	X	X	X
(12) Payload Separation	X	X	X	X	X	X	X

*Subsystems/Elements exclusive of SRMs. SRMs are subject to Fire/Explosion throughout the life cycle (Phases (1) through (10)).

Figure 10-4

DSN: T34D7.TEXT(SYSPHA) AWO: J122

T34D7 PRELIMINARY HAZARD ANALYSIS
(18SEP85) REVISION A

18SEP85

NUMBER	CAT	HAZARD	SUBSYSTEM	PHASE	MM	CO	CS	AT	GD	MD	DE	SC	
MMPHASYS001	A	Impact during ground handling	S/M, MAT, C/C	0-9	X								
				1-5					X				
				1-3			X			X			
				1-2		X		X			X	X	
MMPHASYS002	A	Collision during transportation	S/M, MAT, C/C	0,3	X								
				3			X		X	X			
MMPHASYS003	A/C	Premature/inadvertent engine or attitude control system firing	S/M, ELE, PYR	4-12	X								
				4-10			X						
				8-10				X					
				8-12					X				
MMPHASYS004	A	Element or payload recontact after separation	S/M, C/C	10		X	X	X		X			
				10-12	X				X				
MMPHASYS005	B	Mechanical failure under load (stress corrosion, vibration, shock, or temperature induced)	S/M, MAT, ENV	0-8, 10-12	X								
				1-8, 10-12					X				
				1-8, 10		X	X	X			X	X	
				1-4, 10						X			
MMPHASYS006	B	Container pressure rupture/implosion	S/M, MAT, ELE, C/C	0, 2, 5-12	X								
				2, 5-10			X	X					
				2, 5-12					X				
MMPHASYS007	C	Premature/inadvertent ordnance fire/explosion	C/C, ELE	2-10	X		X			X			
				4-12	X				X				
MMPHASYS008	C	Propellant/oxidizer fire/explosion during servicing or detanking	S/M, C/C	8,9	X				X				
MMPHASYS009	C	Stage fire/explosion	ELE, C/C	1-9	X		X						
				8,9					X				
MMPHASYS010	C	Ignition of flammable atmosphere or materials	MAT, ELE, ENV, HYD	1-10			X	X		X	X	X	
				1-12					X				
				0-12	X								
MMPHASYS011	D	Electrical shock/burns to personnel	ELE, C/C	0-12	X								
				1-5			X		X				
				1-2		X		X		X	X	X	
MMPHASYS012	D	EMI induced electrical system failure	ELE, C/C	2					X		X	X	
				5, 7-12					X				
				0,2,5, 7-12	X								
MMPHASYS013	E	Excessive radiation dose to personnel	MAT, C/C	6-12	X								

CAT CODES: A. Impact/Collision, B. Mech/Struct, C. Fire/Explo, D. Elect Shock, E. Rad/EMI, F. Contam/Toxic/Debris, G. Veh Off-Cours

PHASE CODES: 0. Launch Site Activ, 1. Sub Manuf, 2. Sub Test, 3. Transp, 4. Elem Assem, 5. Elem Test, 6. Sys Integ, 7. Sys Test, 8. Prelaunch Svc, 9. Countdown, 10. Flt Phase 1, 11. Flt Phase 2, 12. Payload Separ.

SUBSYSTEM CODES: See SS-202

FORM 2401 2461

Figure 10-4

DSN: T34D7.TEXT(SYSPHA) AWO: J122

T34D7.PRELIMINARY HAZARD ANALYSIS
(18SEP85) REVISION A

18SEP85

NUMBER	CAT	HAZARD	SUBSYSTEM	PHASE	MM	CO	CS	AT	GD	MD	DE	SC	
MMPHASYS014	E	Radiation induced electrical system interference or damage	MAT, C/C	6-12	X						X	X	
MMPHASYS015	F	Toxic release during processing	S/M, C/C	0-9 1-9	X		X		X				
MMPHASYS016	F	Fuel/oxidizer/N2H4 supply interrupted from contaminants	S/M, MAT, C/C	10 10-12	X		X	X					
MMPHASYS017	F	Debris lodges in mechanical device or shorts electronics	S/M, MAT, C/C	9, 10 9-12 0, 9-12	X		X	X	X		X	X	
MMPHASYS018	G	Vehicle position requires destruct	S/M, PRO, C/C, PYR	10, 11	X	X	X	X	X	X	X		
MMPHASYS019	G	Element/payload premature separation	S/M, ELE, C/C, PYR	10-12 10	X		X		X	X			

CAT CODES: A. Impact/Collision, B. Mech/Struct, C. Fire/Explo, D. Elect Shock, E. Rad/EMI, F. Contam/Toxic/Debris, G. Veh Off-Cours
PHASE CODES: O. Launch Site Activ, 1. Sub Manuf, 2. Sub Test, 3. Transp, 4. Elem Assem, 5. Elem Test, 6. Sys Integ, 7. Sys Test, 8. Prelaunch Svc, 9. Countdown, 10. Flt Phase 1, 11. \'t Phase 2, 12. Payload Separ.
SUBS CODES: See SS-20?

Figure 10-5

DSN: T34D7.TEXT(HAZRPT) T34D7 HAZARD REPORT 10JUL85 : PAGE 1

TITLE: SYSTEM: SUBSYSTEM: SYSTEM CODE: CATEGORY:	CONCURRENCE SAFETY MANAGER: ________ DATE: PROGRAM DIRECTOR: ________ DATE:		NUMBER: REV: DATE: STATUS:	
SYS | CAUSE	CONTROL	VERIFICATION	REFERENCE	STATUS

Operational Phases Applicable:

Launch Site Activation
Subsystem Manufacture
Subsystem Test; Qualification, Acceptance, Etc.
Transportation
Element Assembly
Element Test
System Integration
System Test
Prelaunch Servicing
Countdown
Flight Phase 1 (Park Orbit)
Flight Phase 2 (Final Orbit)
Payload Separation

Hazard Description:

SYS	CAUSE	CONTROL	VERIFICATION	REFERENCE	STATUS

ANNEX N SAMPLE ELEMENT OUTLINE

The first draft of the annexes will be provided with the next release of this ARAR.

N-1.0 DETAILED ELEMENT DESCRIPTION

N-1.1 Primary System

N-1.1.1 Structural/Mechanical Subsystems

N-1.1.2 Ordnance Subsystems
(Data required by AFETRM 127-1 para 3.8.4)

N-1.1.3 Pressurized Subsystems
(Data required by AFETRM 127-1 para 3.8.3)

N-1.1.4 Propulsions and Propellant Subsystems
(Data required by AFETRM 127-1 para 3.8.1)

N-1.1.5 Ionizing Radiation Producing Subsystems
(Data required by AFETRM 127-1 para 3.8.6)

N-1.1.6 Non-Ionizing Radiation - RF and Command Subsystems
(Data required by AFETRM 127-1 para 3.8.5)

N-1.1.7 Non-Ionizing Radiation - Optical and Laser Subsystems
(Data required by AFETRM 127-1 para 3.8.5)

N-1.1.8 Electrical/Electronic Subsystems
(Data required by AFETRM 127-1 para 3.8.2)

N-1.2 Ground Support Equipment

N-1.2.1 Structural/Mechanical Subsystems

N-1.2.2 Ordnance Subsystems

N-1.2.3 Pressurized Subsystems

N-1.2.4 Propulsions and Propellant Subsystems

N-1.2.5 Ionizing Radiation Producing Subsystems

N-1.2.6 Non-Ionizing Radiation - RF and Command Subsystems

N-1.2.7 Non-Ionizing Radiation - Optical and Laser Subsystems

N-1.2.8 Electrical/Electronic Subsystems

N-1.3 Facilities and Interfaces

N-1.3.1 Structural/Mechanical Subsystems

N-1.3.2 Ordnance Subsystems

N-1.3.3 Pressurized Subsystems

N-1.3.4 Propulsions and Propellant Subsystems

N-1.3.5 Ionizing Radiation Producing Subsystems

N-1.3.6 Non-Ionizing Radiation - RF and Command Subsystems

N-1.3.7 Non-Ionizing Radiation - Optical and Laser Subsystems

N-1.3.8 Electrical/Electronic Subsystems

N-1.3.9 Evacuation Plans

(Data required by AFETRM 127-1 para 3.8.9

N-2.0 SUBSYSTEMS DESIGN, OPERATING CHARACTERISTICS AND SAFETY ANALYSIS SUBSYSTEM DESCRIPTION, FUNCTIONS AND INTERFACES

N-2.1 Mechanical/Electrical Schematics

N-2.2 Control Circuitry Schematics

N-2.3 Controls and Operations

N-2.4 Safety Critical Parameters

N-2.5 Hazard Analyses

N-2.6 Major Components and Safety Criticality

N-3.0 GROUND PROCESSING OPERATIONS

N-3.1 Flow Charts

N-3.2 Sequence Description

N-3.3 Transportation and Handling

N-3.4 Hazard Analyses

(Data required by AFETRM 127-1 para 3.4.4)

N-4.0 FLIGHT OPERATIONS

N-4.1 Flow Charts

N-4.2 Sequence Description

N-4.3 Hazard Analyses

N-5.0 HAZARDOUS MATERIALS

N-5.1 Listing

N-5.2 Analyses

N-5.3 Assessment

N-6.0 PERSONNEL PROTECTIVE EQUIPMENT

(Data required by AFETRM 127-1 para 3.8.7)

N-6.1 Usage

N-6.2 Equipment Description

N-6.3 Performance Characteristics

N-7.0 RISK ASSESSMENT

N-7.1 Hazard Analyses Summaries (HA, OHA, IFHA, IOHA, etc.) and Reports

N-7.2 Checklists

N-7.3 Procedures

N-7.4 Failure/Accident Record

N-7.5 Waivers/Deviations

N-8.0 SAFETY CERTIFICATION

APPENDIX B

USFWS CONSULTATION

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE STATION, PO BOX 92960, WORLDWAY POSTAL CENTER
LOS ANGELES, CA 90009

5 NOV 1985

Mr. Dave Wesley
U. S. Department of the Interior
Fish and Wildlife Service
Endangered Species Office
2747 Art Museum Drive
Jacksonville, FL 32207

Dear Mr. Wesley

The Department of the Air Force, Headquarters Space Division, Los Angeles, CA, will modify Launch Complex 41 at Cape Canaveral Air Force Station, FL for the launching of a modified Titan space booster. In accordance with Section 7 of the Endangered Species Act of 1973, as amended, this letter begins the consultation process between our agencies.

The project calls for the modification of various metal structures at Launch Complex 41 (i.e., Mobile Service Tower, Umbilical Tower) to support the launch of a larger Titan space booster. No new facilities are required. This program calls for the launching of two of the modified Titan booster per year for five years beginning in 1988 and ending in 1993 for a total of ten launches in the five years.

Launch Complex 41 was original constructed in 1963-1964. The facility was used by the Air Force from 1964 to 1977 for launching of the Titan space boosters. The original construction and operation of the complex pre-dates most environmental regulations, most notably the National Environmental Policy Act of 1969 and the Endangered Species Act. Since the complex has been unused since 1977 and since the modified space booster is larger than any previous launched from the complex, the Air Force has determined that an Environmental Assessment is required at this time. As part of this effort we recognize the requirements of the Endangered Species Act and will prepare a Biological Assessment, in accordance with Section 7(C) of the Act, for those endangered and threatened species which may potentially be effected by this program. The Biological Assessment will address the modifications to the existing structures and launch operations.

Attachments 1, 2, 3, 4 and 5 are maps and photographs that provide a regional and site specific orientation for Cape Canaveral AFS and Launch Complex 41. Attachment 6 is a 1984 Air Force list of endangered and threatened species found at Cape Canaveral. We understand that there have been changes to this list since that time and request an update from your office.

Based on our preliminary evaluation, the species of primary concern is the Florida Manatee whose Critical Habitat is the Banana River and the

Biological Assessment will focus on the Manatee. However, our Biological Assessment will also address, in less detail, all other endangered of threatened species in the area of Launch Complex 41. Request your concurrence with this course of action. Also if there are other species which you believe should be included as a species of primary concern, request that you notify us at this time.

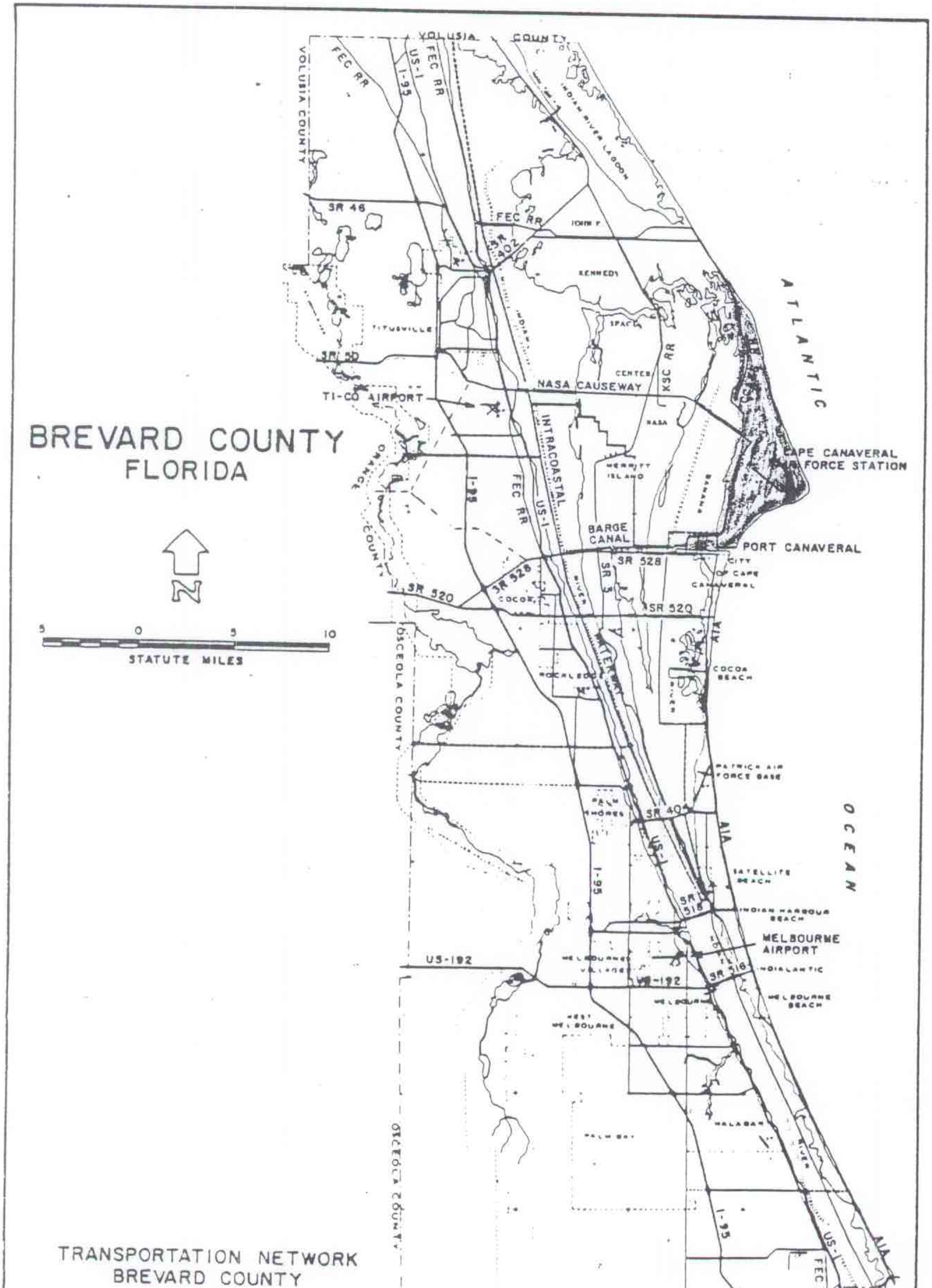
We appreciate your support and cooperation on this issue and look forward to working with your office on this matter. If you have any questions please contact Mr. Robert Mason of my staff at (213) 643-0933.

RoRoig

RAPHAEL O. ROIG
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering

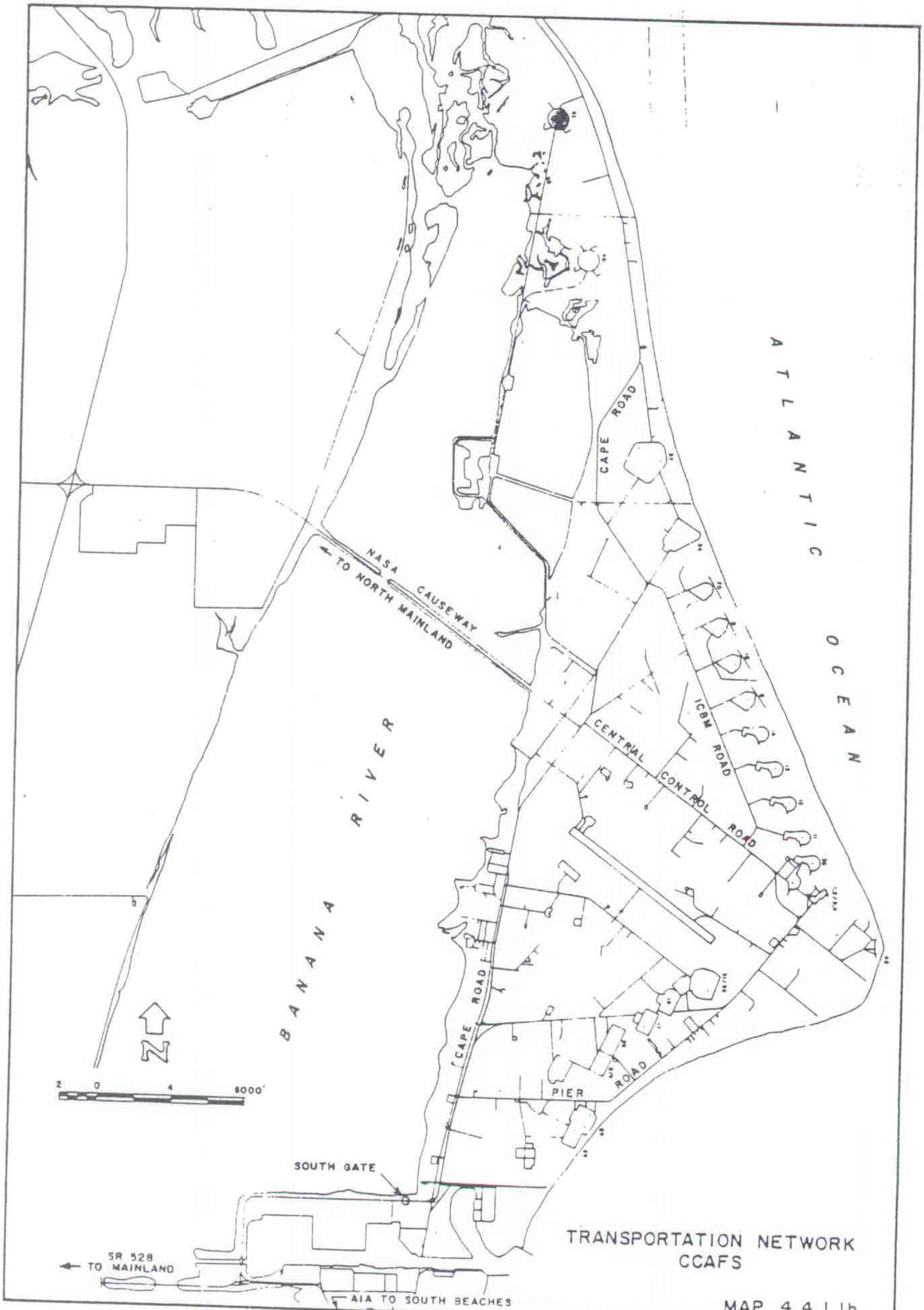
6 Atch
1. Map, Regional
2. Map, Cape Canaveral
3. Map, Complex 41
4. Photo, Titan Area
5. Photo, Pad 41
6. Endangered Species

cc:
SD/YXD
6550 ABG/DE
AFRCE-ER/ROV



TRANSPORTATION NETWORK
BREVARD COUNTY

MAP 4.4.1.1a

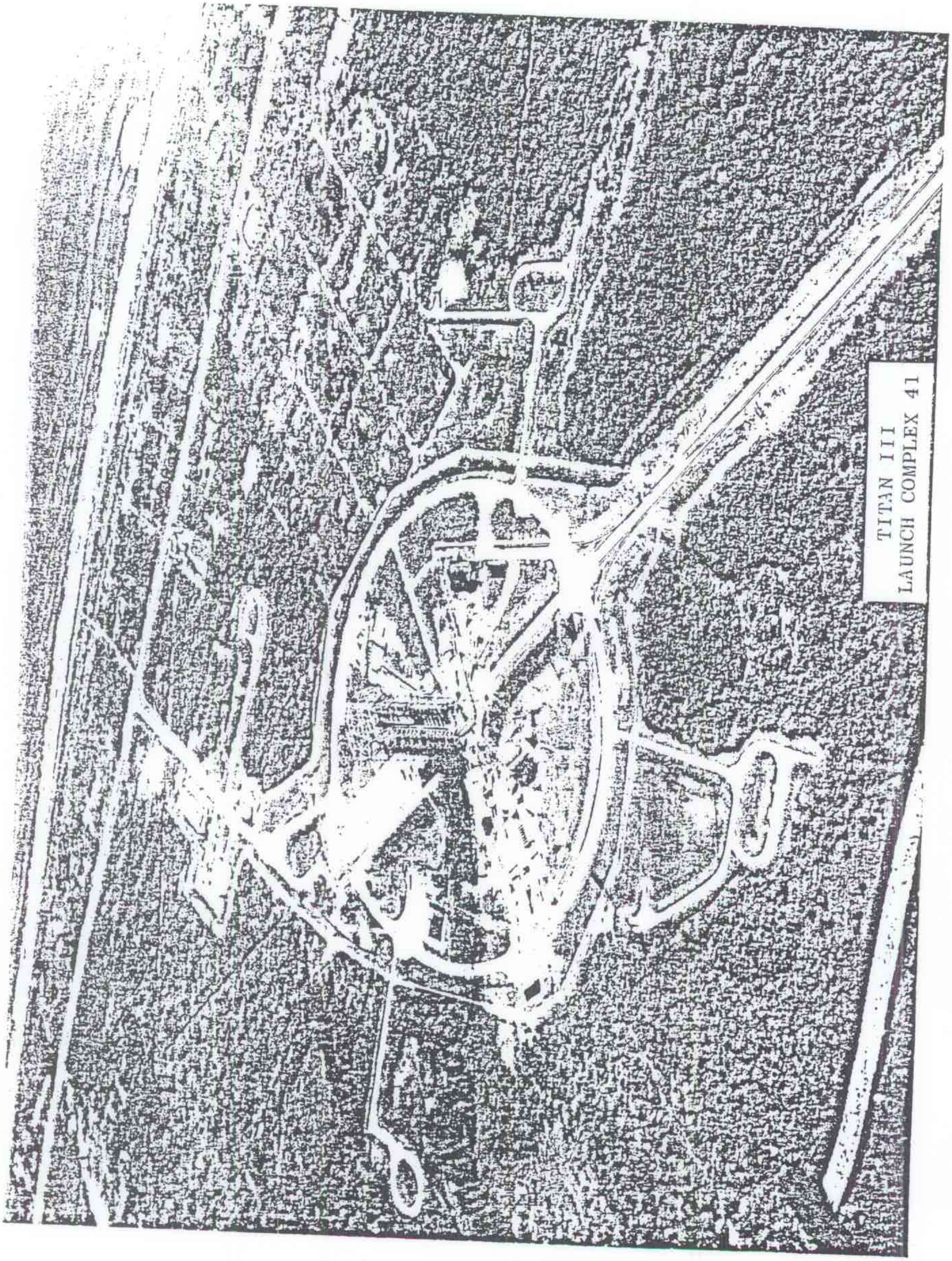


TRANSPORTATION NETWORK
CCAFS

MAP 4.4.1.1b


B A N A N A R I V E R
B A N A N A R I V E R

TITAN III
VERTICAL INTEGRATION FACILITIES
AND LAUNCH COMPLEXES 40 AND 41


TITAN III
LAUNCH COMPLEX 41

ENDANGERED AND THREATENED SPECIES ON AIR FORCE PROPERTY IN USFWS REGION 4

BY COMMAND:

COMMAND	INSTALLATION	CLASS	COMMON NAME	OCCURRENCE	HABITAT	FEDERAL STATUS	STATE STATUS	STATE
AFRES	Dobbins	PLANTS	Twinleaf	4	Rich, moist woods		E	GA
AFSC	Cape Canaveral	MAMMALS	West Indian manatee	1	Canals, rivers, bays	E	E	FL
AFSC	Cape Canaveral	BIRDS	American oystercatcher	3	Mudflats, beaches		SC	FL
AFSC	Cape Canaveral	BIRDS	Arctic peregrine falcon	3	Estuarine, coastal	E	E	FL
AFSC	Cape Canaveral	BIRDS	Brown pelican	1	Estuaries, marine	E	T	FL
AFSC	Cape Canaveral	BIRDS	Dusky seaside sparrow	3	Salt marsh, cordgrass	E	E	FL
AFSC	Cape Canaveral	BIRDS	Least tern	3	Beaches, estuaries		T	FL
AFSC	Cape Canaveral	BIRDS	Little blue heron	3	Marshes, ponds		SC	FL
AFSC	Cape Canaveral	BIRDS	Snowy egret	3	Marshes, ponds		SC	FL
AFSC	Cape Canaveral	BIRDS	Southeastern kestrel	3	Clearings, dead trees		T	FL
AFSC	Cape Canaveral	BIRDS	Tricolored heron	3	Coastal marshes		SC	FL
AFSC	Cape Canaveral	BIRDS	Wood stork	3	Cypress swamps, marsh		E	FL
AFSC	Cape Canaveral	REPTILES	American alligator	1	Swamps, bayous	T	T	FL
AFSC	Cape Canaveral	REPTILES	Atlantic ridley sea turtle	4	Marine, beaches	E	E	FL
AFSC	Cape Canaveral	REPTILES	Atlantic salt marsh snake	3	Salt marshes	T	E	FL
AFSC	Cape Canaveral	REPTILES	Eastern indigo snake	3	Sandhills,streambanks	T	T	FL
AFSC	Cape Canaveral	REPTILES	Green sea turtle	2	Marine, beaches	E	E	FL

ENDANGERED AND THREATENED SPECIES ON AIR FORCE PROPERTY IN USFWS REGION 4

BY COMMAND:

COMMAND	INSTALLATION	CLASS	COMMON NAME	OCCURRENCE	HABITAT	FEDERAL STATUS	STATE STATUS	STATE
AFSC	Cape Canaveral	REPTILES	Leatherback sea turtle	3	Marine, beaches	E	E	FL
AFSC	Cape Canaveral	REPTILES	Loggerhead sea turtle	2	Marine, beaches	T	T	FL
AFSC	Eglin	BIRDS	American oystercatcher	3	Mudflats, beaches		SC	FL
AFSC	Eglin	BIRDS	Arctic peregrine falcon	2	Estuarine, coastal	E	E	FL
AFSC	Eglin	BIRDS	Bald eagle	2	Forested wetlands	E	E	FL
AFSC	Eglin	BIRDS	Brown pelican	3	Estuaries, marine	E	T	FL
AFSC	Eglin	BIRDS	Cuban snowy plover	3	Upper beach lots		E	FL
AFSC	Eglin	BIRDS	Least tern	3	Beaches, estuaries		T	FL
AFSC	Eglin	BIRDS	Little blue heron	3	Marshes, ponds		SC	FL
AFSC	Eglin	BIRDS	Red-cockaded woodpecker	1	Mature pine forests	E	T	FL
AFSC	Eglin	BIRDS	Snowy egret	3	Marshes, ponds		SC	FL
AFSC	Eglin	BIRDS	Southeastern kestrel	3	Clearings, dead trees		T	FL
AFSC	Eglin	BIRDS	Tricolored heron	3	Coastal marshes		SC	FL
AFSC	Eglin	BIRDS	Wood stork	3	Cypress swamps, marsh		E	FL
AFSC	Eglin	REPTILES	American alligator	1	Swamps, bayous	T	T	FL
AFSC	Eglin	REPTILES	Eastern Indigo snake	1	Sandhills,streambanks	T	T	FL
AFSC	Eglin	FISH	Okaloosa darter	1	Clear streams	E	E	FL
AFSC	Patrick	MAMMALS	West Indian manatee	1	Canals, rivers, bays	E	E	FL

Fdc 13D-7-4

United States Department of the Interior
FISH AND WILDLIFE SERVICE
ENDANGERED SPECIES FIELD STATION
2747 ART MUSEUM DRIVE
JACKSONVILLE, FLORIDA 32207

December 5, 1985

Mr. Raphael O. Roig
Chief, Environmental Planning Division
Headquarters Space Division (AFSC)
Los Angeles Air Force Station, P.O. Box 92960
Worldway Postal Center
Los Angeles, California 90009

FWS Log No. 4-1-86-070

Dear Mr. Roig:

This responds to your letter of November 5, 1985, requesting an updated list of federally threatened and endangered species for the Cape Canaveral Air Force Station in Brevard County. Reviewing the list transmitted with your letter, I find several changes are required. The brown pelican was recently removed from the list for Florida and the American alligator was reclassified from threatened to "threatened due to similarity of appearance"; therefore Section 7 consultation is not required on these species. The dusky seaside sparrow no longer exists in the wild. The bald eagle, though not included in your list, is found on the installation.

A species that is also found on the installation but is not listed at this time is the Florida scrub jay. A status survey has been completed for this bird, and we are in the process of preparing the documentation to have this species placed on the list. Officially the scrub jay is considered a candidate at this time and no consultation requirement is associated with this status.

It appears from the description of the project and the aerial photo attached to your letter, if the work is confined to the existing disturbed site, there should not be a problem with the project insofar as endangered species are concerned. We would like however, to review the plans when they become available.

If we can be of further assistance, please contact our office. We appreciate the opportunity to provide our comments.

Sincerely yours,

David Wesley

David J. Wesley
Field Supervisor

APPENDIX C

SPECIES LISTS

Table C-1. List of Marine Invertebrates Collected from the Lagoons Surrounding Launch Complex 39A and the Banana River from December 1979 through June 1981

Family, Scientific Name	Species Collected	
	Lagoon System	Banana River
Phylum COELENTERATA (Cnidaria)		
Cnidaria unid.	X	X
Actiniaria unid.	X	X
Phylum PLATYHELMINTHES (Flatworms)		
Platyhelminthes unid.	X	X
Phylum NEMERTINA (RHYNCHOCOELA)		
Nemertina unid.	X	X
Phylum NEMATODA		
Nematoda unid.	X	X
Phylum ECTOPROCTA (BYROZOA)		
Ectoprocta unid.		X
Phylum PHORONIDA		
Phoronis sp.	X	X
Phylum MOLLUSCA		
Class Gastropoda		
Acteocina canaliculata	X	X*
Acteon punctostriatus		X*
Bermudaclis tampaensis		X*
Caecum cooperi		X*
Caecum pulchellum	X	X*
Cerithium muscarum		X*
Cerithium sp.		X
Crepidula maculosa†	X	X
Crepidula sp.		X
Crepidulidae unid.		X
Diastoma alternatum†		X
Diastoma varium	X	X*
Eupleura caudata		X*
Haminoea succinea	X	X*
Marginella sp.		X
Melongena corona	X	X*
Mitrella lunata	X	X*
Mitrella sp.		X
Nassarius vibex		X*
Odostomia sp.	X	X
Stellatoma stellata		X*
Turbonilla protracta†		X
Turbonilla sp.	X	X
Urosalpinx cinerea		X*
Gastropoda unid.	X	X

Table C-1. List of Marine Invertebrates Collected from the Lagoons Surrounding Launch Complex 39A and the Banana River from December 1979 through June 1981 (Continued, Page 2 of 5)

Family, Scientific Name	Species Collected	
	Lagoon System	Banana River
Class Pelecypoda (Bivalvia)		
Amygdalum papyrium	X	X*
Anomalocardia auberiana	X	X*
Brachidontes exustus		X*
Geukensia demissa	X*	
Geukensia d. granosissima†	X	X
Laevicardium laevigatum		X*
Laevicardium mortoni		X*
Laevicardium sp.		X
Lyonsia hyalina flordiana	X	X*
Macoma constricta	X*	
Macoma tenta	X	X*
Modiolus m. squamosus	X*	
Mulinia lateralis	X	X*
Ostreidae unid.	X	
Parastarte triquetra	X	X*
Rangia cuneata		X*
Tagelus divistus		X*
Tagelus plebeius		X*
Taelus sp.		X
Tellina aequistriata†		X
Tellina mera†		X
Tellina paramera		X*
Tellina tampaensis	X	X*
Tellina versicolor		X*
Tellina sp.		X
Bivalvia unid.		X
Phylum ANNELIDA		
Class Oligochaeta		
Oligochaeta unid.	X	X
Class Polychaeta		
Acesta sp.		X
Amphicteis gunneri		X*
Arenicola cristata		X*
Aricidea fauveli†	X	X
Aricidea fragilis	X*	
Aricidea sp.	X	X
Asychis sp.	X	X
Axiothella mucosa		X*

Table C-1. List of Marine Invertebrates Collected from the Lagoons Surrounding Launch Complex 39A and the Banana River from December 1979 through June 1981 (Continued, Page 3 of 5)

Family, Scientific Name	Species Collected	
	Lagoon System	Banana River
Class Polychaeta		
Branchiasychis americana		X*
Brania clavata		X*
Brania sp.		X
Capitella capitata	X	X*
Chone americana		X
Clymenella mucosa		X*
Diopatra cuprea cuprea		X*
Diopatra sp.		X
Dorvillea sp.		X
Eteone heteropoda	X	X*
Eteone sp.		X
Exogone sp.		X
Glycera americana		X*
Glyceridae unid.		X
Glycinde solitaria	X	X*
Glycinde sp.		X
Goniada maculata†		X
Goniada sp.	X	
Goniadidae unid.	X	X
Gyptis vittata	X	X*
Haploscoloplos foliosus	X	X*
Hesionidae unid.	X	X
Hydroides sp.		X
Maldanidae unid.		X
Marphysa sanguinea	X	X*
Mediomastus californiensis	X	X*
Mediomastus sp.		X
Melinna maculata		X*
Melinna sp.		X
Mercierellopsis sp.	X	
Microphthalmus sp.	X	
Neanthes succinea	X	X*
Nereidae unid.	X	
Paraprionospio pinnata		X*
Pectinaria gouldii	X	X*
Phyllodocidae unid.		X
Podarke obscura	X	X*
Polydora ligni		X*
Polydora sp.		X
Polycirrus sp.		X

Table C-1. List of Marine Invertebrates Collected from the Lagoons Surrounding Launch Complex 39A and the Banana River from December 1979 through June 1981 (Continued, Page 4 of 5)

Family, Scientific Name	Species Collected	
	Lagoon System	Banana River
Class Polychaeta		
Potamilla reniformis†		X
Potamilla sp.		X
Prionospio heterobranchia		X*
Prionospio steenstrupi†		X
Pseudomalacoceras sp.		X
Sabellidae unid.		X
Serpula sp.		X
Spiochaetopterus costarum oculatus	X	X*
Spionidae unid.	X	
Spirorbis sp.		X
Streblospio benedicti	X	X*
Syllidae unid.		X
Tharyx setigera		X*
Tharyx sp.		X
Phylum SIPUNCULIDA		
Goldfingia pellucida		X
Phylum ARTHROPODA		
Class Crustacea		
Copepoda		
Harpacticoida unid.		X
Ostracoda		
Cylindroleberidae unid.	X	X
Podocopida unid.	X	X
Sarsiella disparilis	X	X*
Cirripedia		
Balanus sp.		X
Cumacea		
Cyclaspis sp.	X	X
Oxyurostylis smithi	X	X*
Tanaidacea		
Apseudis sp.	X	X*
Hargeria rapax	X	
Leptochelia dubia	X	X
Tanaidacea unid.	X	X
Isopoda		
Cymodoce faxoni	X	X*
Edotea montosa	X	X*
Erichsonella filiformis	X	X*
Amphipoda		
Ampelisca abdita	X	X*
Ampelisca vadorum	X	X*

Table C-1. List of Marine Invertebrates Collected from the Lagoons Surrounding Launch Complex 39A and the Banana River from December 1979 through June 1981 (Continued, Page 5 of 5)

Family, Scientific Name	Species Collected	
	Lagoon System	Banana River
Amphipoda		
Corophium lacustre	X	X*
Cymadusa compta		X*
Gammarus mucronatus	X	X*
Gitanopsis tortugae	X	
Grandidierella bonnieroides	X	X*
Melita sp.	X	X
Mysidacea		
Mysidacea unid.	X	X
Decapoda		
Decapoda unid.	X	X
Rhithropanopeus harrisii	X*	
Xanthidae unid.	X	
Class Pycnogonida		
Pycnogonida unid.		X
Class Insecta		
Insecta unid.	X	X
Class Xiphosura		
Limulus polyphemus		X
Phylum ECHINODERMATA		
Apodida unid.	X	
Dendrochirotida unid.		X
Holothuroidea unid.	X	
Stelleroidea unid.		X

* Species previously reported as occurring in Indian and Banana Rivers.
† New report of species occurring in Indian and Banana Rivers.

Sources: Reish and Hallisey (1983); ESE, 1985.

Table C-2. Representative Resident Wildlife Species Occurring in the Vicinity of CCAFS and KSC

		Habitat				
Common Name	Scientific Name	Coastal Dune and Strand	Scrub	Flatwood	Hammock	Wetlands
Amphibians						
Green treefrog	Hyla cinerea		x	x		
Oak toad	Bufo quercus		x	x		
Southern toad	Bufo terrestris		x	x		
Leopard frog	Rana pipiens					x
Reptiles						
Gopher tortoise	Gopherus polyphemus	x				
Atlantic ridley turtle	Lepidochelys kempi	x				
Loggerhead turtle	Caretta caretta	x				x
Box turtle	Terrapene carolina	x	x	x		x
Eastern diamondback rattlesnake	Crotalus adamanteus	x	x	x		x
Rat snake	Elaphe obsoleta	x	x	x		x
Florida skink	Eumeces inexpectatus	x	x	x		
Black racer	Coluber constrictor		x	x		
Corn snake	Elaphe guttata		x	x		
Banded water snake	Natrix fasciata					x
Mud snake	Farancia abocura					x
Mud turtle	Kinosternon subrubrum					x
Alligator	Alligator mississippiensis					x
Green turtle	Chelonia mydas					x
Water moccasin	Agkistrodon piscivorus					x
Eastern coachwhip	Masticophis flagellum	x	x			
Atlantic salt marsh snake	Nerodia fasciata taeniata	x				
Eastern indigo snake	Drymarchon corais couperi		x	x	x	
Coral snake	Micrurus f. fulvius				x	
Birds						
American peregrine falcon	Falco peregrinus anatum	x				x
Laughing gull	Laurus atricilla	x				
Scrub jay	Aphelocoma coerulescens	x	x			
Mockingbird	Mimus polyglottos		x	x		
Rufous-sided towhee	Pipilo erythrophthalmus		x	x		

Table C-2. Representative Resident Wildlife Species Occurring in the Vicinity of CCAFS and KSC (Continued, Page 2 of 3)

		Habitat				
Common Name	Scientific Name	Coastal Dune and Strand	Scrub	Flatwood	Hammock	Wetlands
Red-tailed hawk	Buteo jamaicensis		x	x		x
Bald eagle	Haliaeetus leucocephalus			x		x
Osprey	Pandion haliaetus				x	x
Great egret	Casmerodias albus					x
Little blue heron	Egretta caerulea					x
Louisiana heron	Egretta tricolor					x
Snowy egret	Egretta thula				x	x
Great blue heron	Ardea herodias				x	x
Mottled duck	Anas fulvigula				x	x
White ibis	Eudocimus albus				x	x
Gallinule	Gallinula chloropus					x
Kingfisher	Megaceryle alcyon					x
Wood stork	Mycteria americana					x
Pied-billed grebe	Podilymbus podiceps	x				x
Eastern pelican	Pelecanus occidentalis	x				
Double-crested comorant	Phalacrocorax auritus	x				
Ring-billed gull	Larus delawarensis	x				x
Royal tern	Sterna maxima	x				x
Common snipe	Capella gallinago					x
Willet	Catoptrophorus semipalmatus	x				
Common bobwhite	Colinus virginianus		x	x	x	
Red-shouldered hawk	Buteo lineatus			x	x	
Turkey vulture	Cathartes aura	x	x	x	x	
American kestrel	Falco sparverius		x	x		
Barred owl	Strix varia			x	x	
Mourning dove	Zenaida macroura	x	x	x	x	
Belted kingfisher	Megaceryle alcyon					x
Redbellied woodpecker	Melanerpes carolinus			x		x
Fish crow	Corvus ossifragus	x				x
Carolina wren	Thryothorus ludovicianus			x	x	
Boat-tailed grackle	Quiscalus mexicanus	x	x			x
Mammals						
Bobcat	Lynx rufus		x	x	x	
Nine-banded armadillo	Dasypus novemcinctus	x	x	x		
Oldfield mouse	Peromyscus polionotus	x				
Spotted skunk	Spilogale putoris	x	x	x		

Table C-2. Representative Resident Wildlife Species Occurring in the Vicinity of CCAFS and KSC (Continued, Page 3 of 3)

Common Name	Scientific Name	Habitat: Coastal Dune and Strand	Scrub	Flatwood	Hammock	Wetlands
Mammals (Continued)						
Cotton rat	Sigmodon hispidus	x	x	x		x
Raccoon	Procyon lotor	x	x	x		x
Florida mouse	Peromyscus floridanus		x			
Eastern cottontail	Sylvilagus floridanus		x	x		
Opossum	Didelphis virginiana		x	x		
Cotton mouse	Peromyscus gossypinus		x	x		x
Golden mouse	Ochrotomys nuttalli		x			x
Eastern gray squirrel	Sciurus carolinensis			x		
Marsh rabbit	Sylvilagus palustris					x
Rice rat	Oryzomys palustris					x
River otter	Lutra canadensis					x
Roundtailed muskrat	Neofiber alleni					x
Manatee	Trichechus manatus					x
Wild hog	Sus scrofa			x	x	

Source: ESE, 1985.

Table C-3. A List of Fish Collected from the Subareas of the Indian River Lagoon Systems from Summer 1979 through Summer 1980

Family and Scientific Name	Common Name	Species Collected 1979 Mosquito Lagoon	1979 Indian River	1979 Banana River	1980 Mosquito Lagoon	1980 Indian River	1980 Banana River
Dasyatidae							
Dasyatis sabina	Atlantic stingray		X	X	X	X	X
Dasyatis sayi	bluntnose stingray	X		X	X		
Elopidae							
Elops saurus	Ladyfish						X
Clupeidae							
Brevoortia smithi	yellowfin menhaden			X		X	X
Harengula jaguana	scaled sardine	X	X	X	X	X	X
Opisthonema oglinum	Atlantic thread-herring	X	X	X	X	X	X
Engraulidae							
Anchoa cubana	Cuban anchovy	X	X	X		X	X
Anchoa hepsetus	striped anchovy	X	X	X	X	X	X
Anchoa mitchilli	bay anchovy	X	X	X	X	X	X
Ariidae							
Arius felis	hardhead catfish	X	X	X	X	X	X
Bagre marinus	gafftopsail catfish	X	X	X	X	X	X
Batrachoididae							
Opsanus tau	oyster toadfish	X	X	X	X	X	X
Gobiesocidae							
Gobiesox strumosus	skilletfish		X	X		X	
Cyprinodontidae							
Lucania parva	rainwater killifish		X	X		X	X
Floridichthys carpio	goldspotted killifish		X				
Poeciliidae							
Poecilia latipinna	sailfin molly					X	
Syngnathidae							
Hippocampus erectus	lined seahorse	X	X		X	X	X
Hippocampus zosterae	dwarf seahorse	X	X	X		X	X
Syngnathus louisianae	chain pipefish	X	X	X	X	X	
Syngnathus scovelli	gulf pipefish	X	X	X	X	X	X
Serranidae							
Mycteroperca microlepis	gag	X					
Echeneidae							
Echeneis naucrates	sharksucker		X				
Carangidae							
Caranx hippos	crevalle jack	X	X	X	X		
Chloroscombrus chrysurus	Atlantic bumper		X		X		X
Oligoplites saurus	leatherjacket		X	X			
Trachinotus carolinus	Florida pompano				X	X	
Selene vomer	lookdown	X					

Table C-3. A List of Fish Collected from the Subareas of the Indian River Lagoon Systems from Summer 1979 through Summer 1980 (Continued, Page 2 of 3)

		Species Collected					
		1979			1980		
Family and Scientific Name	Common Name	Mosquito Lagoon	Indian River	Banana River	Mosquito Lagoon	Indian River	Banana River
Lutjanidae							
Lutjanus griseus	grey snapper			X			
Gerreidae							
Diapterus auratus	Irish pompano				X	X	X
Eucinostomus argenteus	spotfin mojarra	X	X	X		X	X
Eucinostomus gula	silver jenny	X		X	X		X
Haemulidae							
Orthopristis chrysoptera	pigfish	X	X	X	X	X	X
Sparidae							
Archosargus probatocephalus	sheepshead	X	X		X	X	
Lagodon rhomboides	pinfish	X		X	X		X
Sciaenidae							
Bairdiella chrysoura	silver perch	X	X	X	X	X	X
Cynoscion nebulosus	spotted seatrout	X	X	X	X	X	X
Cynoscion regalis	weakfish	X	X	X	X	X	X
Leiostomus xanthurus	spot	X	X	X	X	X	X
Menticirrhus americanus	southern kingfish	X	X	X	X	X	X
Micropogonias undulatus	Atlantic croaker	X	X	X	X	X	X
Pogonias cromis	black drum				X		
Ephippidae							
Chaetodipterus faber	Atlantic spadefish		X	X		X	X
Mugilidae							
Mugil curema	white mullet				X		
Blenniidae							
Chasmodes saburrae	Florida blenny	X	X	X		X	X
Gobiidae							
Gobionellus oceanicus	highfin goby			X			X
Gobiosoma robustum	code goby	X	X	X	X	X	X
Gobiosoma bosci	naked goby		X				
Microgobius gulosus	clown goby			X		X	X
Microgobius thalassinus	green goby	X			X	X	
Triglidae							
Prionotus tribulus	bighead searobin						X
Bothidae							
Citharichthys spilopterus	bay whiff	X			X	X	
Paralichthys algibutta	gulf flounder	X					
Soleidae							
Achirus lineatus	lined sole	X	X		X	X	X

Table C-3. A List of Fish Collected from the Subareas of the Indian River Lagoon Systems from Summer 1979 through Summer 1980 (Continued, Page 3 of 3)

		Species Collected					
		1979			1980		
Family and Scientific Name	Common Name	Mosquito Lagoon	Indian River	Banana River	Mosquito Lagoon	Indian River	Banana River
Cynoglossidae							
Symphurus plagiusa	blackcheek tonguefish		X		X	X	
Balistidae							
Monacanthus hispidus	planehead filefish	X	X		X	X	
Tetraodontidae							
Sphoeroides nephelus	southern puffer	X	X	X	X	X	X
Diodontidae							
Schilomycterus schoepfi	striped burrfish	X	X	X		X	X

Sources: Mulligan and Snelson (1983); ESE, 1985.